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# THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION

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Bacterial Growths on Artificial Dentures —*Pryor*

Manipulation of Wax—*Thompson*

Pulp Extirpation in Children's Teeth —*Leonard*

Public School Hygienist—*Fones*

Manufacturer and Dentist—*Johnson*

Dental Irregularities—*Dickerson*

Periodontal Diseases—*Merrifield*

Removable Bridgework—*McCollum*

Alveolar Process Resection—*Lucas*

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EDITORIAL

Tooth Cleansing and Bleaching


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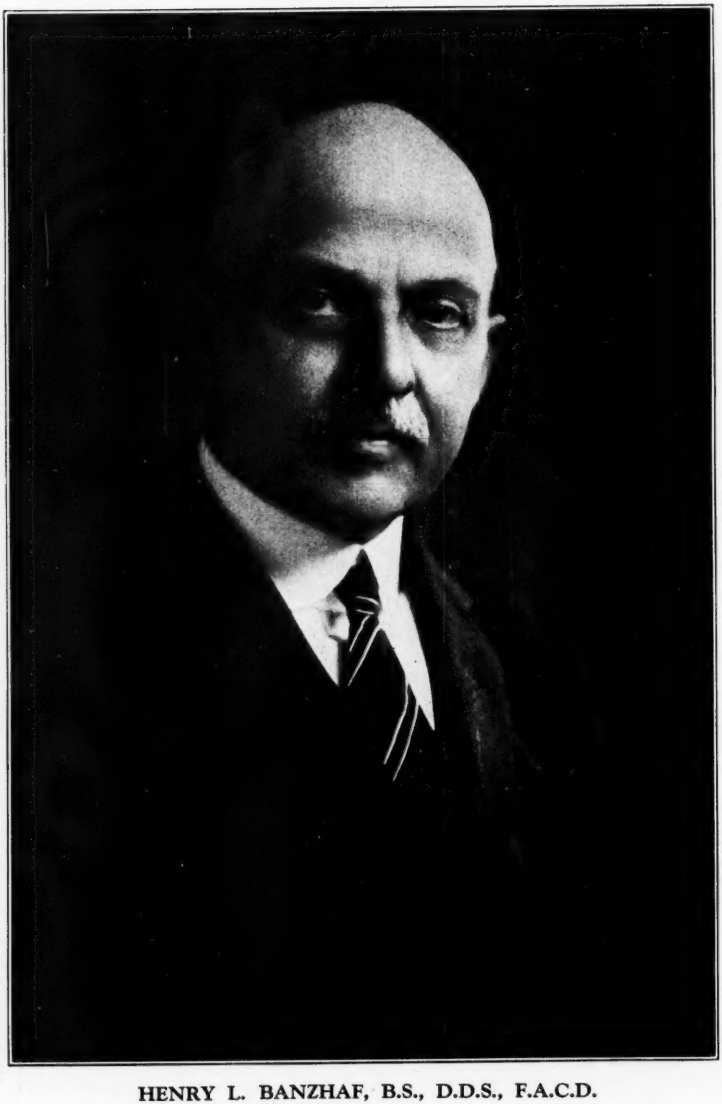

HENRY L. BANZHAF, B.S., D.D.S., F.A.C.D.
First President of the American Association of Dental Schools

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## *Original Communications*

# BACTERIAL GROWTHS ON ARTIFICIAL DENTURES

By W. J. PRYOR, D.D.S., Cleveland, Ohio

(Read before the American Dental Association, Cleveland, Ohio, September 10-14, 1923)

IT IS agreed by most authorities that the condition of the soft tissues within the area covered by an artificial denture usually remains more nearly normal if the denture worn is a metal one.

We have all observed variations from the normal, ranging in varying degrees from the healthy light pink tissue to the soft, angry-looking red—in appearance much like granulation tissue. Various explanations have been advanced as to the cause of this condition, but these explanations being unacceptable, we turn in another direction seeking a more logical solution. The condition being a low type of inflammation, and bacteria usually being the cause of inflammation, our investigation leads to the field of bacteriology, as it applies to various materials used in denture work.

Nägeli[1] found that certain metals, even in minute traces, inhibit the growth of certain bacteria. Copper he found to be very active, pure gold inactive; but gold coin placed in water of a neutral reaction inhibited the growth of the bacteria. He also states that certain bodies such as sulphur, carbon and the like, when placed in water containing the bacteria, along with the metals, deprived them of their inhibitory action.

Miller[2] inoculated tubes of nutrient gelatin with a mouth bacterium. The gelatin was then poured out on a glass plate and pièces of filling gold, some

1. Nägeli: Ueber oligodynamische Erscheinungen in bebenden Zellen Denkschrift d. schweiz naturforsch, Gesel, Zurich, Vol. 33, 1893.

2. Miller: Micro-Organisms of the Human Mouth.

annealed and some unannealed, were dropped on to it. The plate was then incubated for twenty-four hours, at which time the gelatin plate was clouded with the numerous colonies of bacteria. Around the unannealed gold appeared a zone of clear gelatin in which the bacteria developed very slowly. The gold which had been glowed showed no inhibitory reaction (Fig. 1).

Behring[3] tested, in the same manner as did Miller, the action of several metals on several pathogenic bacteria. Abbey's gold cylinders gave a clear zone of

Fig. 1.—Miller, A, B, C, D: annealed; G. E. F.: unannealed.

inhibition with some bacteria but failed to with others. Silver leaf and metallic mercury, and, to a small extent, copper, nickel, and zinc showed inhibitory zones. Tin, lead and iron were negative. Behring also found that mercury and its compounds had just the same effect on all organisms examined. The clear zones tested by inoculation into bullion showed the micro-organisms to be absent. Behring removed the metal and reinoculated the clear zones. In these reinoculations the growth was much retarded, showing that some of the metal must have been in solution in the medium. Behring draws the conclusion that the metals are dissolved by the products of some of the bacteria more readily than by the products of others.

Uffelman[4] tested the effects of metals on cholera bacilli by smearing the surfaces of coins with liquified jelly cultures of cholera bacilli. The bacilli were dead in seventeen minutes after they were smeared on copper coin. Cholera bacilli in a cholera stool smeared on silver coins in the same way were

Fig. 2.—Bolton

dead in twenty-five minutes. On a brass coin the cholera bacilli in a liquified culture were alive after thirty hours, but dead after sixty hours. On platinum foil they were alive after one hour, but dead after five hours.

Bolton[5], experimenting in the same field as Miller and Behring, obtained some very definite and interesting results. He explains that in order to obtain the reactions described, it was necessary to inoculate with a very large amount of pure culture. Where smaller

3. Behring: Zchr. F. Hyg. etc. 60: 482, 1890.

4. Uffelman: Berl klin. Wehnschr. 48: 1212, 1892.

5. Bolton: Tr. A. Am. Phys., 1894-97.

amounts were used, it was often impossible to make out anything but a clear zone, and the peculiar figures described were not obtained. If the layer of medium was too thick, the reaction was also interfered with. The reaction referred to above is an arrangement of the colonies in concentric zones (Fig. 2).

In Bolton's experiments, copper always showed a clear zone averaging 3.1 mm. The results using polished silver coin were about the same as those obtained using pure silver. The zones obtained with *staphylococcus pyogenes aureus* were first a clear zone from 1 to 2 mm. wide, followed by a very narrow zone of intensified bacterial growth. The intensified zone was better marked with silver than with copper and brass and was followed by a second zone of inhibition. His tests with gold were made mostly with purified gold and gold foil, and showed very few zones. When zones were present, they occurred with gold which had not been glowed for several weeks. This he accounted for by the fact, pointed out by Miller, that gold when freshly glowed has no inhibitory power. The zones when obtained were about 1 mm. broad and were sharply marked, and there was also some intensification outside.

Let me here offer an explanation for Miller's finding that *unannealed* gold has an inhibitory action. Miller was a great advocate for the use of copper amalgam, and used much of it. The technic for its use necessitates heating the amalgam, a process that drives off mercury in the form of a vapor. This vapor has a great affinity for gold, and traces of mercury in the atmosphere will cause it to be deposited on the surface of the gold. As mercury has a very definite inhibitory action, this probably accounts for the reaction Miller obtained with unannealed gold. Annealing or glowing the gold would, of course, drive off mercury (Fig. 1).

Recently I have been able to impart to freshly annealed gold inhibitory action by exposing it for one second to mercury fumes. Driving off foreign matter such as mercury and sulphids also restores to gold its property of being welded cold.

Mercury always shows a clear zone. It varied in Bolton's tests from 2 mm. to 20 mm. This may be partly due to the difference in virulence of the organ-

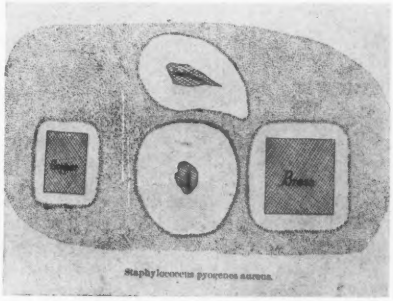


Fig. 3.—Bolton

isms used. Aluminum failed to show a reaction. Pure nickel gave little reaction. Nickel coin gave reaction with typhoid and colon bacilli, but it was possible to detect traces of copper in the medium around the coin.

Bolton says that platinum failed to give any reaction with any of the microorganisms, and concludes that those metals which are resistant toward chemical reagents in general fail to show any reaction, or to only a limited extent. Those that are readily attacked by chemical reagents all exhibit to a very marked degree an inhibitory action, the effect thereby being due to a solution of metal in the medium. Behring stated that the metals were affected by the

products of bacterial growth; however, Bolton found that some of the metals are dissolved out in sterile media (Fig. 3).

In this connection, I want to cite some exceptions to Bolton's rule. Tin, lead and iron, which are readily attacked by chemical reagents, show very little inhibitory action.

At the time Bolton's first work on this subject appeared, he was unable to explain the second zone of inhibition, but three years later in another article he explains it by the fact that the metallic salts themselves have a tendency to creep away from the center and accumulate in one or more concentric circles, often more of the metallic salt being found in the concentric zones than near the center (Fig. 2).

Seifert[6] and Supfle[7], in recent articles on the oligodynamic effect (minute traces) of metals on bacterial growth, confirm the earlier works of Bolton and others mentioned. Supfle agrees that the inhibitory action is due to a simple solution of the metal, and states that there is no need for the assumption that the metals have a mysterious physical force.

Bredig introduced solutions of very pure metals in water for antiseptic purposes. These solutions are termed colloidal or pseudo-solutions, and have great merit as antiseptics, especially the colloidal silver solutions.

Halstead of Johns Hopkins Hospital experimented with metal foils as dressings for skin grafts, and states that silver foil makes an ideal dressing for grafts. Bolton says that silver wire, because of its antiseptic property, is a desirable skin suture in certain cases.

No doubt you have all observed the favorable action of silver nitrate in retarding dental caries. Other germicides equally active and used for the same purpose are soon washed away and decay proceeds. When silver nitrate is properly applied, the metallic silver deposited in the tooth structure remains there, making an unfavorable medium for bacterial growth. I have frequently noticed in cases where decay has started adjacent to an amalgam filling that the dentin directly under the metal is almost immune to the ravages of the decay, which, at times, will entirely encircle such dentin, forming an island of unaffected structure. There is also much proved merit in Howe's silver treatment of infected dentin.

Our culture material being gathered from the mouth, we were given mixed cultures of many different bacteria and fungi.[8] This fact must be borne in mind in comparing results with those of the investigators quoted above, as more uniform reactions can be obtained by using a pure culture. The method used was as follows:

Using a sterile glass rod 4 mm. in diameter, we touched the mucous membrane of the hard palate with the end of the rod, then touched the surface of the denture which comes in contact with the palate and rinsed off the end of the rod in 1 cc. of sterile water. A tube of agar-agar at about 40 C was next inoculated with this water, and the agar was immediately poured into petri dishes, which were incubated for forty-eight hours, when they were examined.

6. Seifert, Walter: München. med. Wchnschr. 67: 1437-8, 1920.

7. Supfle, K.: München. med. Wchnschr. 67: 1166-8, 1920.

8. Acknowledgment is due to Dr. R. G. Perkins, Professor of Bacteriology, Western Reserve University Medical School, Cleveland, Ohio, for helpful advice and also for the supply of culture media; to Dr. H. H. Smith for advice and the loan of laboratory equipment, and to Ney and Company for promptness and courtesy in supplying the metal foils used.

In the vast majority of cases, growths in greater abundance will appear in the dishes inoculated with material taken from under a rubber denture than in the dishes inoculated with material from under a metal one.

However, making tests at random using different patients whose health and mouth conditions varied greatly did not give definite results, so the following experiment was made, using the same patient. In the evening the patient's new vulcanite denture was washed thoroughly. Then a metal foil was burnished with cotton to one-half of the surface which comes into contact with the palate. The denture was worn with the foil in place until morning, when material for cultures was taken from the foil-covered side, and other material from the vulcanite side of the palate. The plates were poured and incubated forty-eight hours, and the following results noted:

*Experiments with tin foil.* The plate inoculated with material from the vulcanite side showed about twice the number of large colonies. However, the plate inoculated from the tin side showed more small colonies, which seemed to be slow in starting to grow.

*Experiments with 24-karat gold foil.* The plate inoculated from the vulcanite side showed about ten times the number of colonies as did the plate inoculated from the gold side. A piece of the 24-karat gold which was worn under the denture was dropped on to the agar plate inoculated from the gold side of the palate, and around this gold developed a growth of staphylococcus.

*Experiments with aluminum foil.* The plate inoculated from the vulcanite side showed hundreds of small colonies, while the one inoculated from the aluminum side showed practically none. More recent tests, however, have shown aluminum to have very little action.

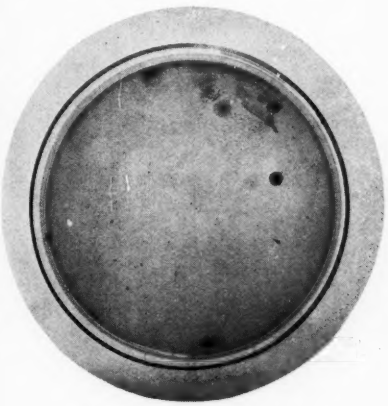

Fig. 4.—Silver foiled side

Fig. 5.—Vulcanite side

*Experiments with platinum foil.* The colonies were about twice as numerous on the plate inoculated from the vulcanite side as in the one inoculated from the platinum side.

*Experiments with silver foil.* The plate from the vulcanite side showed many times the number of colonies as did the one inoculated from the silver side (Figs. 4 and 5).

*Experiments with 20-karat gold.* This test gave a more remarkable result than any of the others, as the plate inoculated

from the 20-karat gold side was practically sterile, while the one from the vulcanite side showed an average number of colonies.

To just what extent these reactions are constant remains to be shown by future experiments, as the pressure of other duties prevented me from repeating them as often as desired, and we cannot accept as a scientific fact anything which has not been proved beyond a reasonable doubt by the work of several responsible investigators. It is fully realized that these results are due in part to the fact that it is impossible to cleanse the surface of a vulcanite denture as readily as a metal one, because of the hundreds of microscopic crevices in the vulcanite which give lodgment to bacteria. A rolled gold also will present a smoother surface than will a cast gold, thus making it easier to cleanse. This can be readily seen in a microscopic examination, using the low power lens.

The theory is advanced by some that the pathologic condition often found in the soft tissues covered by an artificial denture is due to the fact that a rubber denture is a poor conductor of thermal changes, preventing heat radiation from the palate and a consequent overheating. While admitting that there may be an increase in temperature under an artificial denture, let me submit the proposition that it is due to a hyperemia caused by the irritating products of bacterial growth.

The hard palate is normally several degrees cooler than the oral cavity. This is caused by constant passage through the nasal cavity of air which is cooler than body temperature. Therefore, heat is not radiated from the palate into the oral cavity, as the oral cavity is normally warmer than the palate; on the contrary, heat is lost by radiation to the nasal cavity, which is much cooler than the palate.

Tests with litmus, methyl orange and cochineal paper will show acids and carbonic oxid products of bacterial growth present in greater abundance under a vulcanite denture than under a metal one.

Silver of the nobler metals showed the best reaction, and as silver takes very kindly to the human tissues, being used in bone surgery, we have given it consideration as a practical material for use as a denture base. Silver makes a very good baseplate, its fault being that it discolors in the mouth because of the presence of sulphur compounds in the food and saliva. However, by alloying with a sufficient amount of palladium, this fault is overcome.

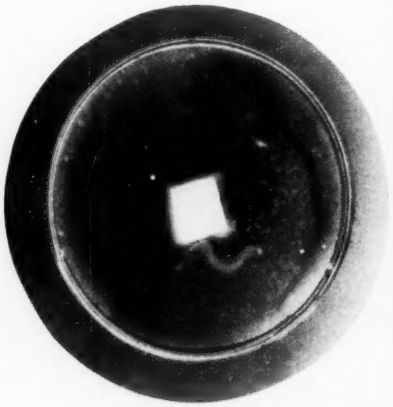

Fig. 6.—Maroon rubber vulcanized

Silver and palladium alloy nicely in all proportions. An alloy composed of one-third palladium and two-thirds silver makes an ideal material for a denture baseplate, because it is very strong and light (only one-half the weight of gold) and polishes to a beautiful white lustre, retaining its lustre better than the gold alloys. During the last year I have constructed no gold dentures, and so far as I can foresee, I do not ever expect to make another one. Clinical results have been very good with silver and palladium, the tissues appearing clean and healthy and the patients more than satis-

fied. Recent experiments tend to indicate that the inhibitory effect of this alloy on bacterial growth is less potent than that of silver alone, but still strong enough to make it rank ahead of the baseplate materials now in use in America.

An alloy of silver and platinum was used quite extensively in England until the rising price of platinum made it too expensive. Since then alloys of silver and palladium have been substituted, but

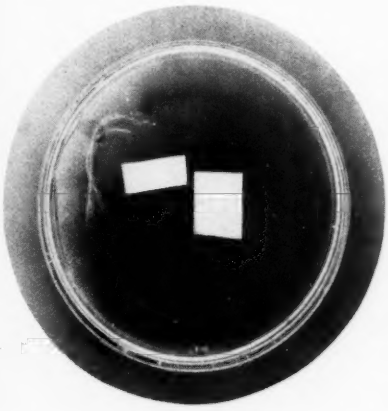

Fig. 7.—Silver

used only slightly, owing to the rarity of palladium in the past. I have no difficulty in obtaining it at the present time, and although the alloy's cost by weight is approximately twice that of gold, an ounce will go twice as far, because its weight is only slightly more than one-half that of gold.

In a recent test using twelve different kinds of baseplate rubber, and numerous metals, it was noted that the colonies showed a very dense growth near the rubber, and in some instances grew right upon it, the organism used being *staphylococcus pyogenes aureus*. In no case did they make themselves at home nearer to the metals (Figs. 6 and 7).

## Conclusions

1. Those patients who can afford it should be fitted with metal dentures. This is not being done at the present time.

2. Excessive festooning should be omitted, as it serves no purpose and makes it much more difficult for the patient to keep the denture clean.

3. Gum pink rubbers which roughen up after being worn awhile should be discarded in favor of those which retain a smoother surface.

4. Festooning on the lingual side is contraindicated, as it gives lodgment to calculus and other debris. It is wasted effort, and is a source of annoyance to patients. The approximate shape of the lingual surfaces of the teeth can be brought out in sweeping curves, avoiding angles, corners and sharp curves. Any change in shape from the anatomic should be a toning down rather than an exaggeration of contours. Some cases we see are an imitation of an advanced pathologic condition.

5. In partial denture work clasps should be constructed to cover as little of the enamel as possible so that the acids formed either by bacterial growth or galvanic action may be readily washed away by the saliva.

6. Dr. Cummer's suggestions that artificial dentures be washed thoroughly several times daily, and also that saliva be flushed frequently through clasp work are accepted as being sound.

## Discussion

*Member:* Can this metal be bought on the market?

*W. J. Pryor:* Yes. Any refiner can supply it to you on special order. I believe Ney and Company are going to carry it in stock as they are having quite a number of calls for it.

As yet I have had no cases where this metal discolored in the mouth, and just this morning I called up a patient who had worn a case for almost a year and she told me that there was absolutely no discoloration.

*Ira G. Nichols, Chicago, Illinois:* It is true that the soft tissues covered by an arti-

ficial denture with a metal base are kept in a healthier state than by vulcanite, owing to the conductivity of the metal, the absence of porosity of its surface, preventing less chance for the lodging of bacteria, and the chemical action with the saliva, which gives them their inhibitory action.

It is hard to determine experimentally whether the conductivity of the metals or the action of the salts of silver, copper, gold, aluminum, etc., are the causes of the greater effectiveness of some of the metals. The order of the effectiveness shown by the paper apparently follows closely both the thermo-conductivity of the metals and the relative inhibitory action of the salts. It is quite possible that both the thermo-conductivity and the inhibitory action of the salts of the metals determine the effectiveness of the dentures made from them. From the vulcanite when saliva acts on it, no active bactericidal substances could be formed as is the case with metals. For example, in the case of aluminum, the relative effectiveness might be due to its higher solubility since it is apparently more effective than some of the metals which are better thermo-conductors, that is, volume for volume.

Vulcanite is a poorer conductor and more porous, and probably its solution in water has less inhibitory action. It is well known that the solution of the metals used have a high inhibitory power, but of course the dilution of these metals in the mouth is high, particularly in the case of platinum and gold. The order of the solubility probably would be aluminum, copper, silver, gold and platinum.

It is readily determined by the microscope that the surface of vulcanite is more porous than that of any of the metals; so, if porosity is the determining factor, it is readily seen that any of the metals are superior to vulcanite. While Dr. Pryor does not decide which one of the three factors has the most effect in determining the greater effectiveness of metal dentures over vulcanite, this much seems clear: that when financial or other considerations make it necessary to use vulcanite dentures, the best interest of the patient would be that the vulcanite denture used should be made as dense and smooth as possible, because a dense, smooth denture would be both a better thermo-conductor and less chance for lodgment of bacteria. This is accomplished by the preparation of a smooth cast, selecting a base with the greatest amount of pure rubber. We all know that vulcanizing against a cast tin foiled produces a highly-polished and dense surface besides the physical advantages and there may be chemical advantages originating from the incorporation of small amounts of tin or tin salts in the surface of the vulcanite.

Dr. Pryor's experiments with tin foil show that the bacterial growth is inhibited.

*Dr. Pryor (closing):* Dr. Nichols asks which is more potent, conductivity, porosity or the inhibitory effect of metal on bacterial growth.

Porosity giving lodgment to debris is the most potent factor in fostering bacterial growth on the dentures. On the other hand, the inhibitory effect of the metals on bacterial growth, together with their smooth surface, is a very potent factor in preventing these growths. Conductivity, as brought out in my paper, I believe is a much less important factor.

Dr. Nichols speaks of the inhibitory effect of tin. While the accompanying illustrations show that agar inoculated from the tin-foil side of the denture presents fewer growths than that from the vulcanite side, I believe that this is due to the fact that the tin, having a smoother surface, simply gives less attachment for the growths. My work and work of the other men seems to show that tin has very little, if any effect.

It was brought out in the paper that tin, iron and lead are three exceptions to the rule that metals rank according to the degree of their solubility. These metals, while readily effected by chemical reagents, show very little effect.

# THE MANIPULATION OF WAX, INVESTMENTS AND CASTING GOLD

By EMORY C. THOMPSON, D.D.S., Warren, Pennsylvania

(Read before the American Dental Association, Cleveland, Ohio, September 10-14, 1923)

MUCH has been written about waxes and investment, but very little has been said about the action of casting alloys. Therefore, only the fundamental points in waxing and investing will be given in this paper, the major portion of the paper being devoted to the physical properties and treatment of our casting golds.

To insure us more uniformly perfect casts, we must have a definite technic. This means that we should not only be well grounded in the fundamentals of cavity preparation, but have a working knowledge in the manipulation of wax, investments and the casting golds.

Waxes are composed of varied proportions of organic and vegetable products and coloring matter, the basis of most inlay waxes being paraffin. Inlay waxes differ in hardness. I prefer a hard wax, as it seems to hold its shape better at mouth temperature.

To soften wax, it should be immersed in warm water. The temperature needed will vary according to the hardness of the different waxes, water from 120° to 135°F. being recommended. The proper temperature depends on the composition of the wax and the individual idea as to the proper consistency for moldability. Wax heated over an open flame is apt to become brittle and flaky on account of burning out the oil of paraffin. Softened wax will crawl under pressure. In compound cavities or three-fourths preparations, it should be confined by the use of a matrix band or a tooth form. When the wax is made moldable by warming, it should be inserted in the cavity and pressure applied in *one direction constantly* for 60 seconds, or until the wax has ceased to crawl under pressure.

The pattern should then be chilled and removed from the cavity and all seating surfaces and margins should be examined in detail to see that there is a good basic impression.

All waxes contract on cooling and this contraction must be compensated for. This can be accomplished by one or more of the three following methods. After obtaining a good basic impression: 1. The prepared tooth is isolated with cotton rolls and the cavity dried. The base portion of the wax pattern is softened by dropping warm water in it with a water syringe or immersing it in warm water to a depth sufficient to cover the basal portion and margins of the pattern. The wax pattern is then placed in the *dry* cavity and pressure is exerted for at least sixty seconds.

2. Wax of a softer formula is added to the dry surface of the basal seat of the basic pattern and pressed to place.

3. The basal seat and all margins are softened with a hot spatula and again pressed to place.

After annealing, the wax is allowed to cool under pressure to mouth temperature. It must not be chilled.

In the indirect method, it is recommended that the cavity in the model from

which the wax pattern is to be taken be lubricated to facilitate the withdrawal of the pattern. (Castor oil and cocoanut oil, equal parts, is a good lubricant.) Otherwise the technic is the same as in the direct method.

The completed wax pattern should be freed of saliva, lubricant or sediment which would interfere with the adherence of the investment while painting by coating it with acetone or alcohol. It should be mounted on a sprue base and immediately invested or covered with a perforated glass dome. It should not be allowed to stand in water as the fungus growth in average water has a tendency to deteriorate the wax and destroy the fine margins.

### Investments

A good investment is equally as important as a good wax pattern. The characteristics and working ranges of the investment materials used should be studied.

Plaster of Paris is the binding material of all investments and also the setting or hardening medium. Taken alone, plaster disintegrates at 372°F., but when combined in proper proportions with silex, marble dust, carborundum, graphite, etc., its heat-resisting qualities are raised sufficiently to withstand the burning out of the wax pattern. The percentage of plaster depends on the method of burning out the pattern and degree of force used in making the cast. The higher the plaster content, the more liable the change of the mold in heating, and the greater force required in casting.

Investments may be divided into two classes according to plaster content: (1) low plaster content investments for the high and medium heat technics—heating to 450°F. and over; (2) high plaster content investments for the quick carbonization and low heat technics—heating to from 300° to 450°F.

Either investment may be used with the low heat technic. A high plaster content investment used for the high or medium heat technic is very apt to crack, contract and disintegrate the mold.

Before using an investment, it must be thoroughly stirred, as the heavier ingredients tend to settle to the bottom of the box from the jarring of the package. The proportions of investment material and water should be weighed to insure uniform mixes. Sixteen parts investment material (26⅔ pennyweight for the average inlay or three-quarter crown) and nine parts of water (15 pennyweight) is recommended. These proportions vary somewhat in very damp or dry climates. Distilled water should be used. Alkaline water hastens the setting of the mix sufficiently to interfere with the proper working of the investment. The investment material, water and all apparatus should be at or near mouth temperature. If investments can be worked at mouth temperature, all shrinkage of the pattern will be avoided.

The mixture should be thoroughly spatulated by rotating the bowl and rubbing the investment against the sides until a smooth, creamy consistency is reached. A large rubber bowl and a rubber spatula curved to conform to the sides of the bowl should be used. Taggart's investment must be spatulated for at least *one and one-half minutes;* the time of others varies. The air should be removed from the mixture by percussion and rotation of the bowl.

In our office, we use a mechanical spatulator, as it gives us uniform results. Hand spatulation is much slower and does not give sufficient time to bring out the fine points in the workability of the mixture. By the use of the mechanical spatulator, we get a more dense, hard and compact investment with minimum shrinkage during burning out and much greater resistance to pressure and heat. We also have a much smoother mixture than would be possible by hand spatulation, and less air bubbles. The personal equation is also eliminated. Motor spatulation takes about one-half the time required for hand spatulation.

### Painting the Wax Pattern

The wax pattern is covered with a film of the investment by the use of a No. 2 camel's hair art brush, care being taken not to introduce air bubbles on the surface of the pattern. We next lightly blow the investment, causing it to flow over the pattern and eliminating any air bubbles that may be left by the brush in withdrawing it from the corners of the pattern. We then place the ring in position and pour the investment down the inner side of the ring until it is full. This will prevent trapping of air around the sprue and pattern. The ring must never be jarred or tapped, as that might cause air bubbles to rise and become pocketed against the wax pattern.

There has been a considerable difference of opinion as to the time required for the crystallization or setting of the investment before burning out. T. W. Maves of Minneapolis, who has made a most careful study of investments, says, "Before subjecting a mold to either the low or high heat carbonization technic, it should be allowed to stand and crystallize at least one hour, and never more than two hours. In support of his statement, Dr. Maves submits the following experiments:

Three 1-inch cubes of investment were made at the same time from the same mixture. They were treated in all respects the same except for the crystallization time allowed. Controlled, even, and gradually increasing heat was applied to the cubes by an electric furnace the same as in the burning out of a mold.

The cubes were tested for resistance by pressure applied with a round, flat-surfaced instrument ⅛ inch in diameter. Cube 3 showed twice the resistance of Cubes 1 and 2, with only one-eighth of their distortion and shrinkage.

### Burning Out the Wax Pattern

Except for the quick carbonization method, the temperature should be raised gradually and uniformly until smoking ceases and the mold should be heated in an oven so that it will be protected from drafts of cold air. A flame should never be allowed to come in direct contact with the mold on account the disintegrating effect it would have on the investment. If a gas flame is used, the oven should have a floor of cast iron covered with a screen so that the mold does not rest on the hot iron floor. The oven should also have a thermometer through the top to measure the degree of heat being used. A few trials will determine the amount of gas to be used to secure the required temperature in a given time.

The electric furnace seems to be the best adapted to the gradual application of heat, and it requires less attention. In our office, we have used a Maves electric furnace for the last five years with most gratifying results. It is practically fool proof, and the danger of overheating the mold, thus causing disintegration and weakness, is reduced to a minimum. It can be used for the high, medium or low heat and quick carbonization methods. It successfully and uniformly accomplishes the three stages in the burning out process. In using the electric furnace for the high heat technic, the mold is placed in the cold furnace sprue hole up, with the cover off and electric

TIME ALLOWANCE

| | Time allowed to crystallize | Resistance to pressure | Distortion and shrinkage from heat | Time subjected to heat in burning out |
|---|---|---|---|---|
| Cube 1 | ½ hour | 35.7 | .040 | 35 minutes |
| Cube 2 | 15 hours | 34.8 | .045 | 35 minutes |
| Cube 3 | 2 hours | 68.0 | .005 | 35 minutes |

switch on "high" to heat up for ten minutes. The cover is put on for the succeeding twenty-five minutes. Then the cover is removed and all molds that have stopped smoking are taken out. The cover is left off and the remaining molds are watched in the furnace, each one being removed as it stops smoking. The temperature required is about 650°F.

The medium heat technic is becoming very popular. The molds are placed in the cold furnace sprue hole up, the cover is put on, and "medium heat" is turned on for one hour and twenty or thirty minutes. The molds are taken out as they stop smoking. The temperature required is from 425° to 450°F. Low plaster content with proper proportion investment and thorough spatulation are required for the high and medium burning out technic.

The low heat technic is the one most universally used and is the most fool proof. It allows latitude for obtaining workable castings from molds somewhat defective because of someone's failure to carry out properly some step in mold production. The molds are placed sprue hole up in the cold furnace. The cover is put on, and "low heat" is turned on for from two and one-half to three hours. The molds are then removed from the furnace when they stop smoking. High plaster investments can be used for low heat technic. If several molds are heated at one time, a slightly longer time will be required for the burning out than if only one or two are in the furnace.

For the quick carbonization method, the procedure as to proportions of investment and water and thorough spatulation are the same as the preceding technics. Mechanical spatulation gives much more satisfactory results than hand spatulation, as an especially hard investment is required to withstand the strain of boiling out the wax and the carbonization of the mold.

The mixture is allowed to stand not more than fifteen minutes so that the free moisture will be retained. This is necessary for the boiling out process. The furnace is heated until the thermometer registers between 650° and 700°F. near the muffle. Then the molds are placed in the hot furnace, sprue holes down, and the furnace cover on. The molds are left in the furnace, the cover on, for fifteen minutes; then they are examined and removed when they stop smoking.

## Principles of Physical Metallurgy

It is my purpose in this paper to discuss a number of principles of physical metallurgy which are of interest to those members of the profession who are concerned with casting, and to limit the discussion to the strictly physical aspects of casting alloys along with a consideration of how such physical aspects are influenced by what might be termed treatment, processing or manipulation.

Before casting came to have such a large place in the making of replacements for the mouth, any knowledge of metallurgy whatsoever was not considered a necessary part of the dentist's equipment. Casting, however, is rapidly becoming a highly developed art, and with its development there have arisen questions of technic which have their solution only in a better knowledge of the basic properties of metals. Whatever mechanical aids might from time to time be developed to make casting more automatic (and it is hoped that there will be many) the fact yet remains that the casting process is essentially a metallurgical operation, and it is becoming increasingly evident that its performance must be guided by some knowledge of the fundamental principles of metallurgy if uniformly successful results are to be expected.

Let it not be assumed that I mean to assert that every operator must undertake a detailed study of metallurgy in order to make successful casting. My position is only this: The melting and casting of a gold alloy is an operation that brings into action a number of the

laws of physical and chemical science, and in order that this action might always be turned to good account, some little knowledge, at least, is required of the fundamentals of these laws.

I am firmly convinced that entirely too much attention has been given in the past to the chemical constitution of casting alloys, and too little attention to the important factor of treatment. This criticism applies both to the profession and to manufacturers. While it is no doubt true that the behavior of a casting gold depends very largely on what elements have entered into its composition, I have been impressed with a belief that equally as much depends on its treatment, and that the practice of making formula the prime consideration has been at the expense of the factor of treatment.

The whole modern tendency among fabricators of all metals is in the direction of simplifying formula and subordinating it in favor of a broader study of treatment. Take steel as the commonest illustration. Fabricators of steel make chemical composition of secondary importance, and its treatment both in the hands of manufacturer and the hands of their own workmen is of primary importance. The fabricator takes the formula of his steel as only a starting point and a matter of routine, knowing that the steel's performance of his requirements will depend on its thermal and mechanical treatment. To him the more important thing is not the steel's chemical composition, but what treatment it has been subjected to by the manufacturer and what subsequent treatment it will be necessary or proper for him to give it.

In the latter years this study of treatment has broadened into a science known as physical metallurgy, to distinguish it from the older and broader study of general or chemical metallurgy. It is a branch of science which concerns itself with the purely physical aspects of the metal. It is a study at close range of the metal's physical and structural constitution. It might be likened to histology and pathology in the biologic sciences. The latter studies deal with cells and tissues in health and disease, while that branch of metallurgy with which this discussion is concerned deals with the minute units of metal known as the crystals and the intercrystalline spaces. It studies the relation of these crystals and their habits to the physical and mechanical properties of the metals.

It is too well known to permit controversy that all modern fabricators of metals on a commercial basis have advanced this science to great profit and advantage, and here in this paper it is my purpose to make use of knowledge already gained, principles already formulated, and methods which have already been standardized. Consequently, no claim is made to originality so far as methods and principles are concerned. I wish merely to apply to a study of dental metallurgy certain principles and methods which have already been of value to other workers, borrowing for our use the knowledge which has been gained through the microscope and other appliances as a foundation.

As the first foundation principle, it must be made clear that the physical and mechanical properties of a metal or alloy—such as strength, hardness, density, resilience, and fusing properties—bear a definite relation to the crystal structure or crystal habits of such metal or alloy. The hardness of steel, the softness of lead, the ductility of gold and the brittleness of bismuth all have their basis in the condition of the component crystals of which they are made up and the cohesion between the bounding surfaces of such crystals.

The study of an alloy, therefore, is largely a study of its crystal habits. And since to vary the properties of any alloy is largely a matter of treatment, and since treatment is so largely bound up with crystal habits and relationships, the first approach to a study of treatment of dental alloys must be through an

understanding of their crystal conditions obtained by aid of the microscope.

It is well known that in the industries it has been shown through the microscope how tempering and annealing takes place in metals. Through that branch of physical metallurgy known as metallography not only can the proper treatment of a metal be outlined, but from a small piece of worked metal the trained observer can tell how the metal has been worked. He can demonstrate the cause of failure in metal that has broken in service, whether it be the section of a steel rail or a dental clasp. He can see the coarse structure which condemns a metal for a certain purpose and point out the faulty treatment that has produced such structure; or he can recognize the fine structure which guarantees a satisfactory performance. He can go so far as to detect the minutest traces of certain impurities which are sure to cause the metal's failure in service, and from knowing the causes which are conducive to failure, he is able to outline the technic which will go far toward the elimination of trouble.

In making dental replacements, it is always the aim of the operator to impart essential and well-defined mechanical properties to his metal. Consequently, it is the ultimate purpose of this study to discover what effect different kinds of treatment have on the internal structure of alloys, with a view to determining what technic at the hands of the operator will produce the best castings.

There are two original considerations: (1) the harmful effects which metallic oxids have on the alloys for dental castings, and (2) the influence which the relative size of the constituent crystal has on the mechanical properties of the alloy. These factors have been given special consideration because they form a study of the utmost importance. The bearing which oxidation has on the physical behavior of casting alloys cannot be overemphasized, and if it seems to be too frequently referred to later, it is because I believe that more casting failures are due to oxidation than to any other single cause.

The accompanying illustrations were taken of various prepared specimens under high magnification.[1] With one or two exceptions, they are casting alloys which are on the market. The variety of conditions which their internal structure reveals shows not only how much influence the operator's technic has on the nature of a casting, but the influence which the manufacturing technic might have as well.

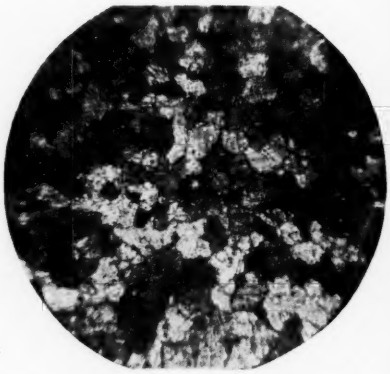

Fig. 1.—Specimen of alloy in cast state, showing typical small crystal structure; × 800.

Molten metals solidify as masses of minute crystals. The crystal is the unit of metal, as the cell is the unit of tissue. All metals in the normal state are aggregates of these crystals. All the physical and mechanical properties of a metal are controlled by the size, shape, condition and orientation of its crystals. Therefore, any study of the nature of metal must begin with the crystal. Just as an understanding of biology must begin with a study of the cell, so must an understanding of the physical properties of metals begin with a study of their crystal habits.

1. I acknowledge the assistance of Mr. H. M. Vernon in the use of necessary equipment.

If we look at a properly prepared specimen of metal under the metallurgical microscope, we see a structure something like that shown in Figure 1. Here we see closely packed crystals of irregular shape, but of fairly uniform size. This gives an idea of a typical crystal structure. Though the picture makes it appear that there are different kinds of crystals present of varying colors, these crystals are all alike in color and composition. The seeming differences in color of the crystals are caused by the different inclinations of the crystal facets, some of

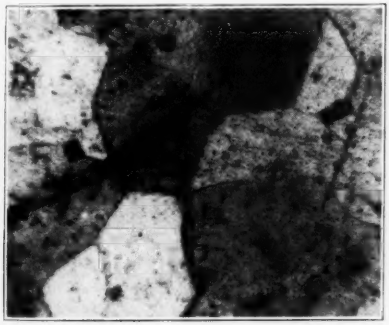

Fig. 2.—Specimen of alloy very slowly cooled to develop large crystals; × 1,000.

which reflect the light away from the microscope objective and thus appear dark. Those which appear lightest have their facets at the proper angle to reflect the light parallel to the optical axis. This might be made clearer if we liken the surface on which we are looking to a well worn sidewalk where the light will catch the uneven bricks at different angles.

This caution against mistaking darker crystals for a different constituent is mentioned because of the limitations of the photomicrograph. The observer in the microscope can by manipulating his light easily distinguish between crystal orientation and varying constituents.

Figure 2 was made from a dental casting, the original magnification being 800 diameters. This illustrates a typical crystal structure for a number of reasons. In the first place, the crystals are well defined and compact. The crystal walls, while clearly outlined, are in perfect approximation, and the specimen is free from oxids and other defects.

The size of the crystals in Figure 1 were quite small. Variation in thermal treatment will produce variation in crystal size. Figure 2 depicts a metal similar in formula to that shown in Fig. 1. Here there are only a few crystals in the entire field although the magnification in the two cases is approximately the same. The difference in the size of crystals in the two specimens has been brought about entirely by a difference in thermal treatment. This metal was cooled from the molten state very slowly. Slow cooling allows crystallization to proceed slowly with the result that large crystals are allowed to develop.

The reason that size of crystal is important to the metal worker is that size of crystal effects the mechanical properties of the metal. The greatest strength of a crystal lies in its walls or boundaries. Consequently, the greater the number of crystal boundaries within the mass of a metal, the greater will be its strength. In this fact lies the difference between a wrought metal and a cast one. In general, a cast metal will have larger crystals, and consequently fewer crystal boundaries, than the same metal when wrought. The rolling and annealing process breaks down the larger crystals into many smaller ones, increasing the number of crystal walls, and thus giving additional surface for intercrystalline cohesion.

The two metals shown in Figures 1 and 2, therefore, while similar in composition, are very different in physical properties, a difference which is due solely to different heat treatment. The metal shown in Figure 2 is much softer than that shown in Figure 1. This difference would be especially noticeable under sudden strains or shocks.

These facts form the metallurgical basis for the principle of cold mold casting. The cold mold chills the molten metal quickly, interrupting the crystal growth and thus producing the small structure, which approximates somewhat the physical properties of a wrought metal. In general, it may be said that the smaller the crystal structure of a casting, the better the mechanical properties of the casting.

Figure 3 shows a metal in which the

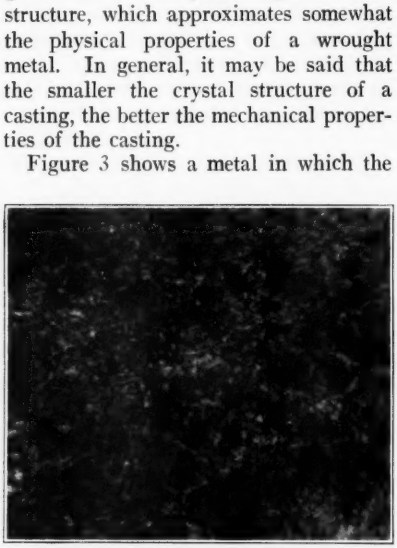

Fig. 3.—Specimen of alloy in normal state, only crystal skeletons being visible, since cooling from liquid to solid state has taken place instantaneously.

structure is so fine that actual crystal structure is hardly discernible. This is the same alloy as the one in which the crystals were very large (Fig. 2), only in this case the metal was thrown while molten into a chilling bath and thus cooled almost instantly. Here only the centers of crystallization or the skeletons are visible. The fully developed crystals have not been given a chance to form. It is the most complete example of imparting the very best mechanical properties to the alloy by thermal treatment. This specimen was not made, however, in a casting machine, and with the limitations of making dental castings, this condition cannot be duplicated in practical work. The illustration has value only in showing a structure of ideal density, strength and uniformity, and in showing what extreme variations one single alloy is capable of under different treatment. The aim in making dental castings is to approach as nearly as possible to this ideal of structure by causing the castings to chill in the mold, that is, to solidify as rapidly as possible.

If this specimen were heated for a prolonged period at a temperature somewhat below its melting point, characteristic crystals such as we have seen in Figure 2 would be developed. This shows that a considerable part of the crystal-forming process occurs after the metal has solidified and while it is cooling down to room temperature.

Rosenhain, a metallurgist who is connected with the National Physical Laboratory of Great Britain, has, by prolonged cooling, formed metallic crystals of a very great size, some of them measuring 1 inch at their greatest dimension.

For many years the word crystallization has been used in connection with fractures of a certain type. Frequently breakage of a metal in service has been erroneously attributed to "crystallization." Metals never break because of crystallization. When manufacturers of casting gold state that their alloys will not crystallize, they manifest an ignorance of fundamental metallurgy.

Failures from fracture are of three general types: (1) failure from sudden shock, or when a stress is applied greater than the metal can withstand; (2) failure from repeated shock, or a repetition of stresses no single one of which is capable of causing rupture, and, (3) failure from internal flaws, such as oxidation and slag inclusions. Failures of the first class are not often encountered in dental constructions, and we shall concern ourselves with failures of the second and third types.

Failures from repeated shock occur frequently in dentistry. The battering of mastication, together with the continued movement of abutments or abut-

ment teeth, apply stress at the weak points of clasp or bridge construction, frequently causing a break. It is hardly possible that the patient could exert a biting force sufficiently great to break a bridge. The repeated stressing, however, breaks the restoration, and it is in failures of this type that the metal is often said to have crystallized. This is not the case. In such cases the crystal walls of the metal have not separated, but the line of fracture has passed through the crystals. It was formerly believed in such cases that an actual crystallization had occurred, and that the line of fracture had followed the crystal boundaries and that there had been a separation of crystal face from crystal face. It is well known today that when a metal suffers a repetition of stresses, the resulting fracture does not follow the crystal boundaries, but passes through the crystals themselves. It is only because such a fracture seemed to exhibit a crystal structure that men have thought the stress had crystallized it.

The third general cause of failure—oxidation, slag inclusion, pipes, blowholes, etc.,—are contributory factors to Classes 1 and 2. Slag inclusions are seldom encountered in dentistry. They occur mostly in iron and steel, and are mentioned only in the general heading. Pipes, blowholes, etc., are of frequent occurrence, and they are caused directly or indirectly by oxidation. They are prolific trouble makers. All workers of metal are familiar with the oxid coating formed when metals are heated. This occurs with all metals except pure gold, pure silver and pure platinum, and a few of their alloys. But when copper or any other base metal is alloyed with gold, considerable oxidation takes place on heating.

So long as the heat is insufficient to melt the metal, this oxid coat is purely superficial and may be removed by pickling. When the metal is molten, however, this layer of oxid is absorbed into the body of the metal. It does not alloy with the metal, but it does penetrate the mass of molten metal, where it remains suspended throughout the heating operation. The capability of this oxid being absorbed by the mass of molten metal is a phenomenon of the utmost importance. The capacity of a gold alloy containing copper or other base metals to absorb its own oxid has not sufficiently been brought to the attention of the profession, and yet more failures are caused every day by oxidation than by all other causes combined. Every man who has melted gold is familiar with the characteristic oxid coat which forms on the surface of his melted gold, but the fact that this oxid coat is being constantly absorbed or taken into the body of the gold all the while that it is held in a state of fusion, and the fact that this occluded oxid is a most prolific source of trouble are facts of the most vital importance.

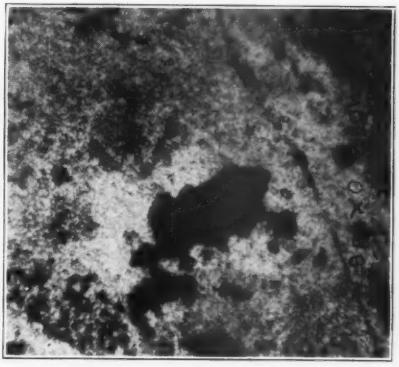

Fig. 4.—Specimen of pure copper, showing occluded copper oxid practically always contained in copper; × 1,000.

Oxids within a metal can usually be very clearly seen with the aid of the microscope. The oxid areas generally appear black against a lighter ground of metal. The affinity of copper for oxygen is such that pure copper almost invariably contains copper oxid, and typi-

cal studies of internal oxidation can admirably be made by pure copper.

Figure 4 shows a specimen of chemically pure copper under the microscope. The actual field of which this photograph is a magnification is about 1/10 mm. in its longest dimension. The black portions are copper oxid. There are several large areas of this oxid, and the entire surface is mottled with it. This make of copper is the one generally used for alloying dental gold. If this copper is used to make an alloy, the oxid present here is carried into the alloy unless some means are employed to eliminate it in the process.

Fig. 5.—Eutectic alloy of silver and copper, showing oxid in crystalline formations; × 1,000.

Figure 5 is an unusually good picture of internal oxid in a metal. It illustrates some of the habits of internal oxid and helps to explain how such oxidation is a source of difficulties. This is an alloy of silver and copper, known as the eutectic alloy. This alloy was selected because it is one which allows the oxid to form in a natural state. The alloy crystallizes around the oxid without breaking up the oxid particles. It was melted in a crucible furnace and given an opportunity to oxidize. The oxid is the black in the center of the illustration. The photograph is a magnification of an area equal to about half the area of the head of a pin. Each particle of oxid is a point of weakness. At these points fractures start under extreme or repeated stress, and the fracture follows the lines of least resistance, extending from oxid particle to oxid particle. The oxid crystals are not isolated crystals found after a tedious search; the specimen is full of them, as a lower magnification shows.

Measurements taken between particles in this same specimen as shown in Figure 5 show these oxid crystals to be no farther than ½ mm. apart, although the average distance is about ¼ mm. apart. This means that at every ¼ mm. there is a point of weakness. The specimen shown in this picture is not excessively oxidized, and yet there is enough oxid present to impair the metal's strength measurably. Thousands of dental castings are put in service containing more oxid than this specimen contains.

The formation in Figure 6 shows admirably one of the habits of internal oxidation which is worth careful consideration in the work of making dental castings. The oxid is in well-defined forms or crystals and it is not scattered in myriads of minute particles. When the oxid first forms on the surface of the melted metal and begins to be absorbed by the mass, the particles enter in the form of the minutest spheres, scattering and spreading throughout the mass of the melted metal. As the fusion continues, however, they begin to coalesce, and if fusion is continued long enough, they soon unite into crystals or masses of considerable size. Of course, the larger these oxid masses in the metal are, the greater are the points of weakness. It is manifest that if a small amount of oxid is scattered through the metal in the minutest particles, the strength properties of the metal will not be seriously impaired. It is where considerable coalescence has taken place and where large points of weakness are generally scattered through the metal that repeated stress will result in fracture.

This is a point in favor of keeping the metal in a state of fusion no longer than is absolutely necessary. It is a point in favor of a blowpipe which has enough heat to melt the metal quickly so as to permit casting quickly. It is a point against the long-drawn-out melting of the lower temperature blowpipe. It is the long and continuous melting of the gold that is much more liable to affect the alloy adversely than it is high heat. Men frequently express the fear of getting their gold too hot. If care is used and casting done quickly, the danger of too little heat, or rather too prolonged a melting, is much greater than is the danger of too high a heat. The metal should be cast at the point where it quivers under pressure of the blowpipe and draws in at the bottom of the button. This is at a stage just before it approaches a white heat. If carried to the point of white heat with boiling and spitting fine particles from the mass, its usefulness for casting has been destroyed until it has been refined. Too high a heat causes excessive shrinkage.

One must remember, also, that as gold is melted repeatedly, it accumulates these oxids. This accounts for the fact that after casting alloys are melted a few times, they begin to show signs of deterioration. It is often thought that the reason for this deterioration is that certain of the alloying elements in the gold have "burned out." This is not the case. What happens is that oxids are burned in. The metal generally deteriorates because of the accumulation of the metallic oxids.

When any casting is made with an alloy that contains metallic oxids or in which the oxids have been allowed to accumulate, the casting is pretty certain to have a tendency to brittleness and sluggishness.

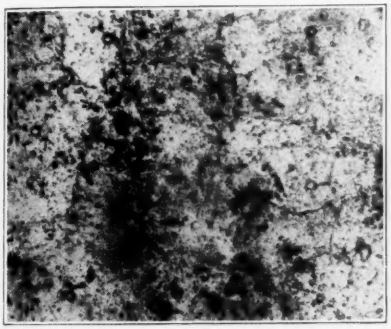

Fig. 6.—Section of a cast clasp broken in service, showing oxid imbedded in metal; × 1,000.

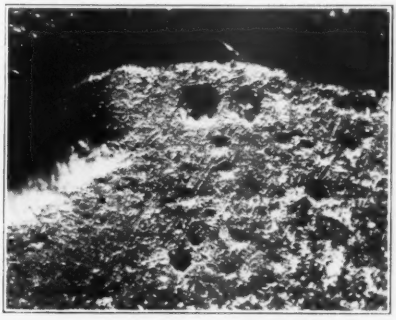

Fig. 7.—Section of cast clasp which failed in service, showing blowholes and general weakness.

In Figure 6 is shown an internal view of a cast clasp which broke in service. Every dentist is familiar with the broken clasp failure. To the naked eye there was no visible imperfection in the casting, but the microscope shows it to be full of copper oxid which was imparted to the alloy either when it was melted or imparted to it when the alloy was originally made. The fact that the oxid can creep into the metal when it is made is not to be overlooked. The black spots scattered through the field are oxid. All parts of this casting showed oxidation, but there were a number of close groupings like the one in the center of the picture.

Figure 7 shows a section of a casting with blowholes. They are directly

caused by oxidation. When a condition like the one shown here is seen on the outside of a casting, it presents a surface which every man who has polished a casting is familiar with—a finely reticulated area which refuses to take a perfect polish. It is that area which looks slightly rough or porous. This is an oxidized area. It is made up of the minutest pits and blowholes in a dense group. Frequently larger pits and blowholes are found in the area.

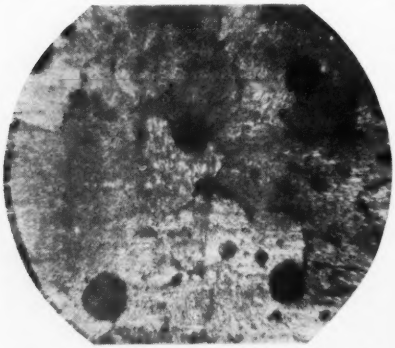

Fig. 8.—Section of casting alloy, showing blowholes due to oxidation; × 600.

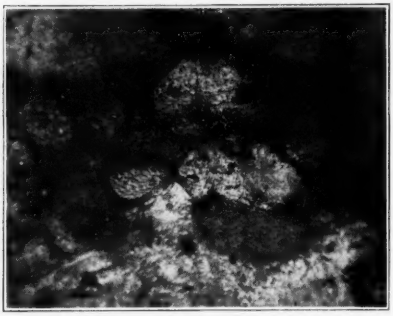

Fig. 9.—Section of oxidized area between blowholes of a clasp casting gold, showing metal badly contaminated with oxid; × 1,000.

Figure 8 shows another case of oxidation manifested again in blowholes. It is interesting to note that this specimen is an alloy sold with the claim that it would not oxidize regardless of the number of times it was melted. The specimen was melted just once. I would hesitate to say that the manufacturer intended deliberately to misrepresent his alloy. The more charitable view would be that he apparently is not familiar with the fact that his alloy absorbed oxids while he was manufacturing it. Large and small blowholes are seen generally scattered through the entire field. The metal cannot be said to have density and strength.

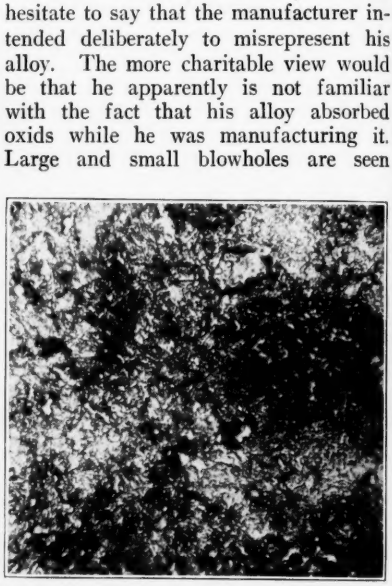

Fig. 10.—Section of alloy in normal state, showing fine crystal structure free from oxid; × 1,000.

A higher magnification of the same specimen on a different field is shown in Figure 9. A spot was selected between blowholes in order to give a more detailed examination of the defective structure. The crystals are filled with minute particles of oxid which have interfered with the crystal habits of the alloy. It will be noted that the crystals are not of uniform size. There is a noticeable lack of compactness and density.

Figure 10 shows a specimen which is free from oxid, photographed at the same magnification as the one in Figure 9.

One should note the fine, compact crystal structure, the absence of black areas, and the general appearance of density and uniformity. This specimen is a casting that has the full strength of the metal.

In Figure 11 is shown still another section of badly oxidized casting alloy. This is a well and favorably known manufacturer's casting gold, a test casting of the alloy being shown. The casting was made under ordinary conditions. The oxid is seen covering the entire field. It

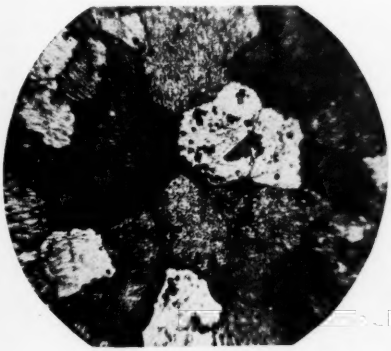

Fig. 11.—Section of badly oxidized casting alloy, showing crystals separated by oxid, imparting general weakness; × 500.

is noticed not only between the crystal walls, but imbedded in the crystals of metal as well. Externally, this casting seemed to be sound and dense, but the microscopic examination shows a weakness throughout. The crystals here are too large to give the metal the best mechanical properties.

To have its best mechanical properties, a cast metal should be made up of small crystals, densely packed together and intertwining. Large structure and looseness of structure as a general thing indicate a metal with less desirable properties. The strength of a metal depends very largely on the cohesion between the individual crystals. Anything that separates the faces of the crystals usually effects the cohesion and reduces the strength of the metal.

In this specimen (Fig. 12) showing oxidation again, large oxid areas are seen between the crystals of the metal. When the metal solidified, the oxid forced the crystals apart. This metal is made weak through lack of cohesion between the crystal faces. This is a cast specimen of one of the well-known alloys sold for three-quarter crown construction. A three-quarter crown which possesses a structure like the one shown

Fig. 12.—Section of casting, showing large and loose crystal structure with oxids separating crystals and imparting weakness; × 800.

here is very liable to lack the strength required of this type of construction.

It might be emphasized at this point that these oxids get into castings in two possible ways: The manufacturer may impart it when he makes the alloy, and the operator is practically sure to impart it when he makes the casting. It is practically impossible to melt an alloy with a blowpipe, using the ordinary type of casting machine, without imparting more or less oxid to the alloy. Tests have proved this. Dozens of castings have been made using every type of blowpipe and casting machine and casting gold in an effort to find a blowpipe melting which is absolutely free from oxid. In every one more or less oxidation can

be found, although in some cases it has been found to be very slight. Generally speaking, the extent of the oxidation depends on the temperature of the blowpipe and the length of heating, together with the habits and skill of the operator. The only cautions that can be given are these: With a small hot flame, a blowpipe must be used which is in good working order and which allows perfect control of the flame, with a flame that is sufficiently hot to melt the gold rapidly so that the gold will not be held unduly in a state of fusion. The alloy must not be kept molten any longer than is necessary. A flame that has a distinct reducing cone or area should be used, and the reducing cone must always be kept on the metal. The reducing cone of the flame is that area which keeps the metal bright. Incidentally, it is the hottest part of the flame. As long as there is a film of oxid riding on the surface of the gold, that oxid film is being absorbed by the gold to contaminate it; therefore, one should try to keep the metal bright with the reducing flame. The use of niter (saltpeter) or any flux containing a nitrate should be avoided, as these are oxidizing agents and only bring about what we are trying to avoid. The hydrogen blowpipe causes less oxidation and gives a smoother and freer flowing gold than any other.

As to the casting gold, manufacturers frequently make the mistake of stating that their alloys do not oxidize. Strictly speaking, this is not true. All of the casting alloys will oxidize when they are heated. The only exception might be made of an alloy of gold and silver, and an alloy of this type, because of its unusual softness, is very limited in its serviceability. All of the alloys containing gold, silver, platinum and copper, which are the basic metals in all casting alloys, will oxidize when melted. What the manufacturers should work toward are processes of combining their alloys in such manner that they will not contain oxids when they are furnished to the trade. This can be done as a number of the pictures in this collection will indicate.

Fig. 13.—Section of casting, showing small crystal structure and absence of oxids; × 1,000.

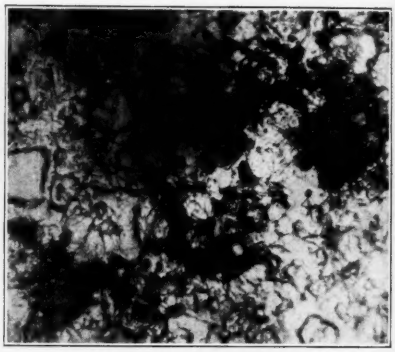

Fig. 14.—Specimen of casting, showing oxid areas and crystal separation; × 1,000.

For example, in Figure 13 is shown a specimen of an alloy combined in such manner as to preclude the formation of oxids. None of the oxid areas can be detected in the field. The difference between this structure and the one shown in Figure 12 should be noticed. The crystal structure is very fine and compact (Fig. 13). The walls or boundaries are hardly visible because the crystals are

so closely packed. It is this small structure, the intertwining of the crystals, and the density and uniformity which give the metals desirable mechanical properties. This is a specimen of an alloy made for three-quarter crowns, a process of manufacture being used which prevents occlusion of oxids.

In Figure 14 is shown still another oxidized alloy that has been melted twice to compare with the specimen shown in Figure 13. This is an alloy not manufactured by a process designed to eliminate oxidation. Here oxidation has become much more general than it has in Figure 13 and seems to have proceeded farther. At this stage in the alloy, it becomes increasingly difficult to put the finish to the three-quarter work required on account of running into bad areas on the surface already referred to. The properties of shrinkage and expansion are also liable to be changed because of the difference in the oxid's coefficient of thermal expansion. It should be noticed that oxid surrounds nearly all the crystals, and that the crystals are of very uneven size. A chemical analysis of this specimen would show practically the same proportion of elements that were used to make it. Although badly deteriorated, the proportions of the various metals have not been changed. Nothing has been burned out, but oxygen has been burned in.

Figure 15 shows a section through an inlay. This is another example of very little oxidation. The crystals are practically free from any masses between the walls. The small crystals indicate a dense alloy. Inlay golds are less complex than the harder casting alloys, and their tendencies to oxidize are not so great. The gray crystals show a different color only because of the angle of the facets with relation to the light rays of the microscope. There is less oxid in this specimen than there would be if the metal were one of the harder, more complex alloys. Since inlays do not have to stand the same mechanical stress that other forms of restorations do, the presence of oxid is less liable to work injury to the casting.

Figure 15, in common with most of the others shown, is that of a casting made in a cold mold. In Figure 16 is shown the same inlay gold as that shown just before, only cast in a hot mold. The oxid seen here is only the accidental oxidation of the melting operation. The melting was carried on a little longer

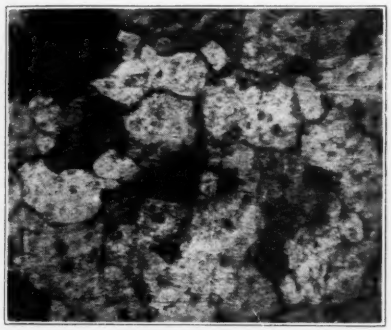

Fig. 15.—Section of an inlay deeply etched, showing minimum oxid accumulation during casting, and small and closely packed crystal structure; × 500.

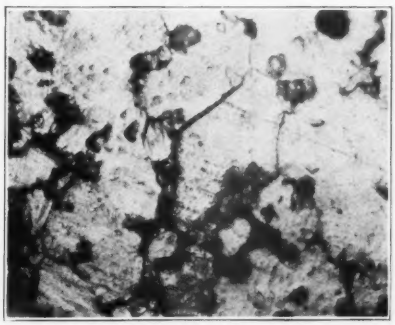

Fig. 16.—Section of casting cast in a hot mold, showing larger and less desirable crystal structure and oxid imparted in casting operation; × 800.

than it should have been because of the bulk of metal used. The illustration is included, however, to give an idea of the much larger crystal structure and consequently the less desirable physical properties imparted by the hot mold casting. The structure apparently lacks the density of the specimen in Figure 15. Hot mold casting allows the crystals to develop to greater dimensions, because the molten metal solidifies at a slower rate and because the solid metal cools down more slowly.

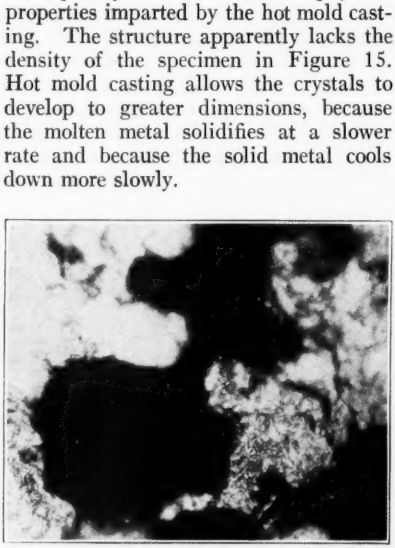

Fig. 17.—Section of casting alloy intentionally oxidized, showing large dendrite of copper oxid; × 1,000.

Figure 17 shows an extreme case of oxidation. This specimen of casting gold was deliberately oxidized by prolonged and faulty blowpipe technic just to show to what extent oxidation can proceed. The large dendrite of oxid covers almost the entire field.

This is an alloy that contains a considerable proportion of palladium, and although the palladium is by no means responsible for the extreme condition shown here, there is a good deal of question as to the value of that metal in a casting alloy. Palladium is used in many of the casting alloys on the market, and, so far, I have not been able to learn what virtues are claimed for it as an ingredient by the manufacturers who use it. It is known that palladium effects the color of a gold alloy adversely, especially when copper is also present. The greatest objection, however, is that it further complicates the alloy, increasing its affinity for oxygen; that it raises the fusing point unduly, and that it makes complete and thin fusion of the metal more difficult.

In general, it may be said that the simpler the alloy, the better. Practically all the properties essential to any casting gold can be obtained by various proportions of gold, silver, platinum and copper. If these four metals are properly proportioned and scientifically alloyed, the weight of the argument is against the use of palladium rather than in favor of it. Palladium is used either as a substitute for platinum or in conjunction with it, and while it raises the fusing point of the alloy in which it is used more than platinum does, it contributes nothing as a hardener, as does platinum.

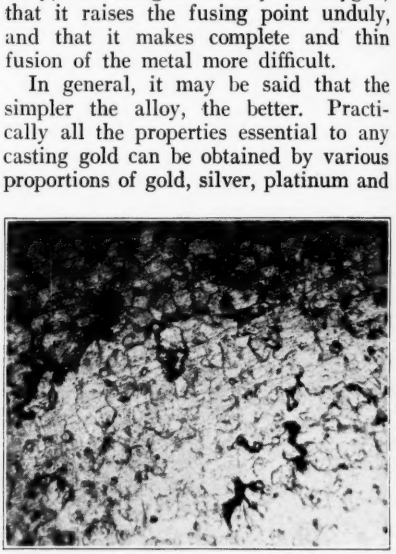

Fig. 18.—Section of casting, showing fine crystal structure, density, and minimum of oxidation; × 1,000.

In Figure 18 is shown what might be considered an exceptionally good specimen of casting. There is some oxid in the field, but a comparatively small amount. This is one of the harder alloys used for cast clasps, bars, etc. One should notice here the very small crystals, uniform in size, and locked together with the mechanism of interpene-

tration. Here is the evidence of a dense, strong casting which probably never would break down in service.

In making this casting, the operator had an alloy to start with which was entirely free of metallic oxids. If there is oxid present in an alloy to start with, no amount of careful melting technic will eliminate it. The first elimination of oxid from the alloy is "up to" the manufacturer. Careful melting in the dental laboratory will largely prevent its further formation, but will not eliminate it when

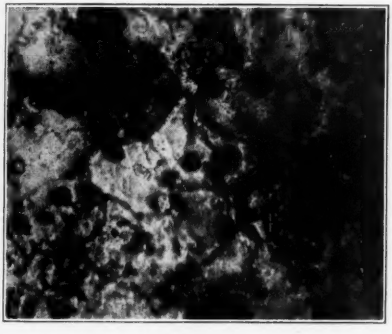

Fig. 19.—Section of casting made of partly new metal and partly excess button, showing loose structure and oxidation; × 1,000.

it is once formed. Reducing fluxes will assist in preventing oxidation, but their value in removing oxids has not been proved.

Figure 19 shows a section of a casting using one of the most popular of the clasp casting golds. It is just another example of oxidation which is seen both in the form of blowholes and intercrystalline films. One will also note that the crystals are very large and that uneven size and loose structure are manifest. When satisfactorily melted, this alloy is one of the best on the market of its kind, but, on account of the oxid present to begin with and for reasons which have to do with its composition, it is a difficult metal with which to secure a clean melt. The specimen is from an actual casting, but it contains an excess button which has been melted over several times and consequently shows a worse structure than it would if all the metal were new. This metal shows rapid deterioration on repeated meltings.

## Summary

To summarize briefly, the following points should be observed in the technic of casting:

1. Melting should be done in such manner as to avoid oxidation, since internal oxids separate the crystal boundaries and impart weakness to the metal. To do this, the melting should be done in the reducing flame, which is that part of the flame just ahead of the inner cone, and the area which keeps the metal bright. Flux should be used judiciously.

2. One should cast into a cold mold, since the rapid chilling of the molten metal produces smaller crystals and greater density. Chilling interrupts the crystal growth. Where resilience and hardness are desired, the small crystal structure should be sought. One should bear in mind that the rapid freezing of the molten metal, however, which is accomplished by chilling, does not mean that there is any added value in plunging the mold into cold water. What is referred to here is that stage of chilling which converts the liquid metal into the solid. This should happen in the shortest possible space of time—in a flash—and after the metal is solid, its treatment then is a matter to be considered later.

3. Melting should be done rapidly. Slow melting, in addition to permitting oxidation, tends to bring about segregation of the constituents. A blowpipe should be used which will deliver sufficient heat to fuse the alloy rapidly.

4. Absolute cleanliness of metal and melting equipment must be observed. The most minute particles or certain impurities and foreign matter which might accidentally contaminate the metal might

ruin a case on which many hours have been spent. One should not melt scrap as casting gold since scrap, no matter how clean, is always a doubtful quantity. Only gold intended for the work under construction should be used, and the specifications of the manufacturer should be observed. One should be as careful in the specifications of the materials for construction as the engineer is in his construction. It will save time and trouble.

This fact must always be kept clearly in mind: Faulty castings are the result of flaws in the internal structure of the metal, and these flaws are more often invisible than visible to the naked eye.

In their purest and newest state, casting alloys are none too good, and the casting technic of the operator always tends to deteriorate them and not to make them better. Excess buttons which are to be used over again should be cleaned carefully. Gold tends to pick up mineral impurities from investment compound which are injurious. Excess buttons which appear to be excessively oxidized should be discarded and new metal used. A rough, scaly, or porous surface on an excess button is external evidence of bad oxidation. It is good practice to use as much new metal as old, and to have no more excess than is necessary to make a good cast. The melting tray of one's machine should be kept clean. Any scale or dross which collects upon it should be scraped away. A clean melt cannot be made upon a dirty tray.

5. Clasps and other parts in which resilience is desired should be tempered. This is accomplished in exactly the reverse order of tempering steel. The casting should be heated to a low, red heat, and allowed to cool slowly; the slower the cooling, the better the resilience of the tempered part. When maximum softness is desired, the process is reversed. The casting should be heated to a low, red heat, and just as redness disappears, it should be plunged into water.

To pickle, only sulphuric acid should be used, about a fifty-fifty mixture. Castings should be pickled by heating the acid and not by dropping the hot casting into cold acid.

By no means should hydrochloric or muriatic acid be used as a pickling agent. Recent experiments have shown that this acid can seriously injure certain gold alloys by an electrochemical action which sets up internal fractures. Sulphuric acid is the best for all sorts of pickling.

6. As to the blowpipe, one should remember that a hot, efficient flame is to be desired. I have been experimenting with a hydrogen blowpipe, and can recommend it for efficiency and cleanliness. The manufacturers of casting gold condemn the acetylene blowpipe, but some workers seem to be getting satisfactory results with it. Natural gas and air are generally inefficient, and where only natural gas is available, oxygen should be used in connection with it. Coal gas in some localities works very well with air both for soldering and casting. Combined with oxygen, coal gas will produce a temperature that will fuse platinum.

Hydrogen and air under pressure, with oxygen in reserve, is perhaps the cleanest and best all-round blowpipe fuel, and it will no doubt be more widely used in the future.

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# PARTIAL PULP EXTIRPATION IN CHILDREN'S TEETH

By NORRIS C. LEONARD, D.D.S., Baltimore, Maryland

(Read before the American Dental Association, Cleveland, Ohio, September 10-14, 1923)

IN THE development of a method that is based on the most reasonable hypothesis which has been carefully compared with the best established scientific thought, the clinician in dentistry must regard his results, however satisfactory to himself, only as evidence, and not as proof, in presenting it for the consideration of the profession. On the other hand, consistently good results following a theory and technic without obvious and violent scientific inconsistencies through a long series of cases are entitled to a rank as evidence in proportion to the need of the profession for a better method in the particular field of their application.

The feeling that better methods are needed in the treatment of certain phases of the lesions of children's teeth is greatly emphasized when viewed from the orthodontic standpoint; and this has led me to present a subject which is now outside my province as a clinician, but which engaged my attention through many years of general practice, during which the favorable results of a method confirmed my belief in the hypothesis on which it was founded, and the apparent success of a very simple technic.

It is unfortunately true that the scientific value of methods involving treatment of vital pulp lesions is very difficult to demonstrate, and the most careful observer may be honestly misled without the friendly criticism and help of other clinicians in the same field; so this will be my justification in offering a clinical report devoid of so many of the elements of scientific research, and enveloped so largely with empiricism. The subject, at least, is of importance, and some of the observations may be suggestive enough to point the way to a more thorough scientific investigation, and perhaps stimulate constructive criticism.

So far as I am aware, there is no recognized method for safely caring for deciduous pulp exposure, or for those in young permanent teeth which have occurred as a result of early decay before the root apexes have been completed. It is to these two classes of cases, which in several respects are somewhat analagous, that the method which I wish to discuss is applicable, and the conservation of which so intimately concerns the orthodontist.

The use of this method dates back to near the beginning of pressure anesthesia for the removal of vital pulps, about 1898, as disclosed in the literature. My satisfaction with pressure anesthesia applied to permanent teeth soon led me to experiment with it on deciduous teeth. Immediately I was confronted with the problem of root filling in the latter class which seemed from every standpoint impracticable.

Extirpation of only the coronal portion of the vital deciduous pulp was then begun as an experiment, dressing the remaining stumps of the pulp with an aseptic and mildly disinfectant paste, and sealing the cavity with a permanent filling at the same sitting.

This method was satisfactory from the

beginning, and was used with only slight modifications of technic through approximately twenty years of general family practice, during which time my records will show several hundreds of cases to which it was applied. There was no effort made to select only favorable cases. All definitely vital and exposed deciduous pulps were treated in this way with remarkably consistent results. There was no pain or swelling, no soreness or other evidences of abscess, and the shedding in all cases noted was apparently in a perfectly physiologic manner. Every vestige of the roots was absorbed, as well as much of the dentin in the coronal portion. Less than 1 per cent of the cases were failures.

My assumption was that the abundant vascularity due to large apical foramina and, usually, partly absorbed root apexes would compensate for the traumatic injury, favor the repair of the pulp stumps, and cause their vitality to be retained. This latter is the question to be determined, and this perhaps shall be the measure of the value and safety of the operation.

My own interpretation of the evidence, which I admit is incomplete, is entirely favorable, though I should not like to say conclusive. Roentgen-ray examinations have proved negative, and the difficulties of adducing conclusive evidence are obvious.

In order to present the case more clearly for a close examination and fair analysis, a detail of the technic as practiced should be given. When the carious cavity has been cleansed of debris as thoroughly as practicable, with chisels and excavators, and washed well with tepid water, the saliva is dammed back with cotton rolls and napkins; the cavity is wiped out with cotton pellets, flooded with some good disinfectant, and wiped dry again with cotton. Any overlying decalcified material is then quickly removed to make the pulp exposure complete and free. A small portion of a cocain and epinephrin anesthetic pellet, which has been previously prepared, is placed with sterile pliers directly in contact with the pulp, then deliquesced by the addition of a drop of water or normal salt solution. A pellet of soft yellow wax, large enough to a little more than fill the cavity, is then placed in such a way as to confine the anesthetic against the pulp and prevent its escape. Gentle pressure is then made against it with the finger or with a large pellet of cotton held in the pliers.

The deciduous pulp is peculiarly susceptible to cocain anesthesia, and usually there is hardly a twinge of pain in producing complete pulp anesthesia that renders the rest of the operation painless and assures the control of the patient.

The wax is quickly removed from over the exposure and, with a sterile large round bur ready in the handpiece, the coronal portion of the pulp is cut away, leaving the excised stumps bare at their entrance to the canals. The empty pulp chamber is then flooded with one of the essential oils, usually oil of cinnamon, for its disinfectant effect. Then a bland, aseptic, nonirritating and mildly antiseptic paste, about the consistency of soft butter, which has already been prepared, is placed in the pulp chamber and against the exposed pulp stumps, patting the paste gently, without producing undue pressure, with cotton pellets held in the pliers until the excess of fluid has been absorbed by the cotton and the mass is fairly compact.

The preparation of the cavity should then be completed and the restoration made with a permanent filling, at the same sitting, if possible; if not at that sitting, the paste dressing should not be disturbed at a subsequent one.

The paste used is prepared on a convenient mixing slab just before the operation, and is composed of three parts of oxid of zinc cement powder to one part of Aristol, mixed with Ceylon cinnamon oil to about the consistency of soft butter. This is used simply as a bland, aseptic

and mildly antiseptic surgical dressing which possesses sufficient disinfectant qualities to inhibit growth of pathogenic organisms that may have been left on or near the surface of the wound. It hardens slightly but very slowly; care to avoid undue pressure in introducing the filling is important.

There are doubtless many other combinations that would be just as efficient for the purpose, and perhaps better, though for a satisfactory surgical dressing of this nature there are certain obvious qualities that are essential, among them freedom from ready solubility of its elements in the tissue fluids.

Bleeding of the pulp stumps at the time of the operation should not constitute a contraindication to immediate dressing with the paste and immediate filling, as the bleeding will be controlled mechanically.

The entire operation should not require more than ten or fifteen minutes to the time the tooth is ready for the permanent filling. If the psychology of the patient is to be considered a factor in the result, this fact alone would seem to make a favorable contrast with a method published recently by a recognized authority in pediodontia in which six visits to the office were required for treatment of deciduous exposed pulp.

I am aware that this technic as briefly outlined is open to many objections from the standpoint of aseptic surgery. But in defence I would say that any method to be of value must be practicable, and in this particular field ideal conditions are impossible to create. So we must accept things as they are, and meet conditions as best we may, trusting to overcome adverse circumstances with dexterity and care. To meet intelligently the conditions that Nature has imposed by instituting a successful compromise between conservation and destruction is the practical test; for a sound theory, impossible of application, is as unscientific as one that is openly inconsistent with proved physiologic and biologic laws.

The technic as outlined is the one used in the series of cases mentioned. In the face of necessarily variable conditions that would usually be expected to modify the results, those observed have been so consistent and invariable as to justify a reasonable doubt concerning our present understanding as to the exact reaction of vital pulp tissue to surgical trauma within healthy areas, even though, from the nature of the operation, the introduction of a small amount of infection cannot be excluded.

The analogy referred to, which associates the young and incompleted permanent teeth with deciduous teeth, is evidenced by the open root ends and the peculiar vascular areas which immediately surround their apexes because of the building and absorptive processes respectively. Because of this analogy and the apparent success with deciduous teeth, it seemed justifiable, in the absence of any recognized method for successfully caring for this class of cases, to undertake an adaptation of the same method for a series of experimental cases in the young and incomplete permanent teeth with exposed vital pulps, on the hypothesis that the pulp stumps would remain vital and the formative organ continue to function to the completion of the root ends.

Unfortunately, the experiment has been handicapped by a lack of available material. This, however, it is hoped to remedy soon through the cooperation of the school clinics. In Baltimore, the work has been started with the help of very efficient clinicians, and so far the reports have all been favorable. The technic as stated has been only slightly modified from that used in the deciduous series.

That the proposed series of special cases of pulp extirpation in permanent teeth of pa-

tients between the ages of 6 and 10 years may be treated more uniformly, the following mode of procedure and technic is suggested:

1. Case history—age of patient, general health, etc.

2. Radiographs of tooth to be operated on, to determine stage of root development. If practicable, the corresponding tooth in the opposite side of the arch should be radiographed for later comparison.

3. Excavate, and wash thoroughly with tepid water.

4. Apply rubberdam, and dry cavity.

5. Remove more thoroughly the decalcified material about the pulp, securing, if possible, a free, clean exposure.

6. Sterilize with generous application of carbolic acid, or oil of cinnamon, and wipe dry.

7. Apply pressure anesthesia, using either cocain or novocain pellets for the purpose.

a. A small portion of a pellet is placed with a sterile instrument in contact with the pulp. Then a drop of sterile water is added—just enough to dissolve completely the anesthetic pellet.

b. This solution is then confined against the pulp exposure with soft yellow wax that is built into the cavity.

c. Pressure is then applied with the finger upon a pellet of yellow wax placed so as to seal the cavity and act as a plunger against the solution.

8. The wax is then removed, and the cavity is wiped out with oil of cinnamon. With a sterile large round bur the coronal portion of the pulp is then cut away, and all debris removed from the pulp chamber, which is then flooded with cinnamon oil to destroy, if possible, any remaining bacteria.

9. With a sharp round bur or a nerve broach having a flattened knife-edge point which is slightly curved, the pulp in the root canals is excised about the coronal third, and removed with the broach, allowing the apical portion to remain intact with as little traumatic injury as possible. This part of the operation should be done with a bur or broach moist with the cinnamon so as to avoid as nearly as possible carrying living germs along with the instrument.

Figs. 1 and 2.—Roentgenograms of lower left first permanent molar just before partial pulp extirpation, and following operation and immediate filling, showing formative crypt and incompleted roots.

10. The open canal is then wiped out with a blunt sterile absorbent point.

11. The canal is then filled with a paste which has been previously prepared on a convenient mixing slab, and which is composed as follows:

Fig. 3.—Roentgenogram of corresponding tooth on opposite side of arch, made at same time as films 1 and 2.

Oxid of zinc (cement powder)....3 parts
Aristol—powder .....1 part

mixed with oil of cinnamon to the consistency of soft butter.

This paste is conveyed with a smooth broach to the canal, and worked with gentle pressure into the canals, and in contact with the remaining stump of pulp tissue that has been left in the apical portion of the root.

Bleeding should not constitute a contraindi-

cation to the immediate dressing of the canals with this paste, as the mechanical effect of the paste will effectually control the hemorrhage.

When the canals have been filled with the soft paste, the latter should be gently tamped with pellets of absorbent cotton, held in the pliers, in order to remove any excess of fluid. If necessary, to make the dressing fairly compact, additional paste of a stiffer mix may be added.

In the absence of unfavorable symptoms the paste dressing should not be disturbed at subsequent sittings, allowing it to remain a permanent root filling.

Figs. 4 and 5.—Roentgenograms of lower right and left first permanent molars, six months after operation.

Only one case, the first one, by Dr. H. H. Street of the Johns Hopkins clinic, is far enough advanced to justify a report: Dean P., aged 10 years, sent from a public school clinic, had a lower right first permanent molar aching from carious exposure of pulp. Soothing application was made and appointment was given for a few days later. The pulp was removed, June 16, 1922, according to the technic described above, using cocain-epinephrin anesthesia. Radiographs of the tooth immediately before and after the operation, also of the corresponding tooth on the opposite side are shown in the accompanying illustrations. No pain or discomfort whatever followed the operation. The patient returned in a few days for cavity restoration. Subsequent radiographs were made Dec. 8, 1922, Jan. 12, 1923, and September 4.

Fig. 6.—Roentgenogram of same tooth shown in films 1, 2 and 5 fifteen months after extirpation, showing root apexes apparently completed.

Fig. 7.—Roentgenogram of corresponding tooth on opposite side, with pulp exposure; this tooth had no treatment and is shown only for comparison.

It will be observed that this technic provides for removal of the coronal third of the pulp from the canals. This is to provide better protection to the stumps from bacterial invasion by reducing their

proximity to areas of possible recurrence of decay, while at the same time limiting the canal operation to a point within the field of easy and visible access.

Again the question arises, will the stumps of the pulp remain vital in the canals indefinitely, even though it can be demonstrated that the vitality will persist for a considerable time? There can be no definite answer, of course. From my own point of view, however, both clinical and theoretical, there seems much safe ground on which to base a favorable expectancy.

There is really very little similarity between this operation and that of the so-called pulp capping which is of such doubtful value, and which I should be among the first to condemn save in exceptional cases. The surgical removal of the infected portion of the pulp which is excised at a point safely distant from the infected areas of carious dentin would seem, from a practical standpoint, when the wound has been suitably protected with a nonirritating permanent dressing, to give much more favorable chances for repair and persistent vitality, aside from the factor of the greatly lessened amount of pulp tissue to be supported by the same vascularity.

The repair of pulp tissue and its ability to adapt itself to a new environment by protective cell proliferation is entirely consistent with clinical observation as well as conservative histologic deduction, which, as Noyes observes, "makes the supposition necessary that an embryonal connective-tissue cell may develop into any specialized form, and that the kind of cell into which it develops will be determined by the character of mechanical stimuli which it receives."

Certainly the search for a remedy which could be depended on to conserve this very important class of teeth and safely avert the evils that are associated with their loss, or with apically infected roots as a result of premature loss of vitality, and consequent imperfect canal treatment, would justify the cooperation of every clinician whose field of operation is touched by this blighting influence.

## Discussion

*Harry E. Kelsey, Baltimore, Maryland:* I feel that many might take a drastic view of this subject, maintaining, as Dr. Leonard does, that pulp devitalization should not be practiced in view of its great importance to the tooth from a developmental standpoint, and this to the development of the whole jaw. Of course, to the orthodontist the fact that the temporary tooth maintains the space in the jaw for its permanent successor and thereby aids in the development of the jaw itself is of immense importance. If this method which is presented to you can preserve these temporary teeth for two or three years until the period of their usefulness is passed, and maintain their health and function in mastication and in a condition in which they will be normally absorbed, then it is worthy not only of consideration but of adoption. If they cannot be so preserved, as a rule, then, it would be a menace to attempt it. But as a matter of fact, temporary, and even nonvital teeth, are constantly left in the mouth without any treatment at all. In clinics we see thousands of them that are receiving no care at all, many of them with nonvital pulps, and unquestionably infected but not so sealed up that the results of infection cannot be discharged through the pulp and out into the mouth. When they become so infected as to cause abcesses, it has been our belief that these teeth would not absorb.

With regard to the first permanent molar, it seems to me that this method presents some similar features to the old method we pursued a good many years ago, namely, mummifying the pulp, but we generally devitalized the pulp before the operation. Dr. Leonard's idea is to preserve the remnant of the pulp alive so that the calcification of the root may be carried on. It must be for the general practitioner to decide by clinical observation whether the tooth can be preserved alive long enough to permit of complete calcification of the root and whether this will occur occasionally or generally if the operation is properly performed, and whether the percentage of successes will outweigh the percentage of failures; finally, whether it is an operation which, if it does fail, will be so serious in its results as to preclude its use as a practical procedure. The orthodontist is anxious for some better way of preserving the teeth for the child until the development of the teeth and jaws has taken place. If Dr. Leonard has presented a method which on

investigation will prove efficacious and safe, then it merits support and adoption.

*M. Evangeline Jordan, Los Angeles, California:* I should like to ask Dr. Leonard how he would deal with an hysterical child having a copious flow of saliva, between the age of 18 months and 3 years. I have limited my work to this field for the last fifteen years, and while occasionally I have used the method referred to by Dr. Leonard, I find that pulp extirpation is necessary in many cases where we could not apply a local anesthetic. In some of our cases where local anesthesia has been used, the pulp was infected at the time and infection was driven down into the root canals ahead of the anesthetic, with resultant trouble. We frequently find an abscess occurring two or three months after removing a pulp in this way. I have found that the easiest way is to apply a very minute disk containing a small amount of arsenic. The pulp can be removed within twenty-four hours.

The physical resistance of children is often so much below par that there is a recurrence of trouble, especially after the period when there was so much influenza, we found that in many cases that had been in perfect condition for two or three years, the patients returned with an apical abcess.

Dr. Leonard's method of treating the first permanent molar has been followed practically along the same line in my office for about eighteen months. That has not given time to satisfy us thoroughly that no further trouble may occur, but it seems to me that this is the only way to handle those incomplete roots of the first permanent molar in patients between the ages of 8 and 10 years.

*Arthur H. Merritt, New York City, New York:* I should like to ask two or three questions. Dr. Leonard recommends the use of cocain. Has he had unsatisfactory experiences with procain? Also, it is not clear whether he filled the tooth immediately following his treatment of the pulp. And finally, has he found any irritating effects from the oil of cassia? Some years ago I noted in a magazine than an investigator claimed that the oil of cassia was irritating.

*H. H. Johnson, Macon, Georgia:* I have not used Dr. Leonard's exact method in dealing with those fragments of nerves we observe left in the roots of teeth where the pulps would not stand for capping. On exposure, it is probable that the pulp has already become infected. We remove the infected part, and if we have not pressed the infection farther into the roots of the teeth, then we may expect that these fragments of nerves may, under proper treatment, remain without giving any trouble. That is one thing we have to be very careful about in using pressure anesthesia, namely, not to infect further the canals by force. Instead of the wax, I have used unvulcanized rubber with great satisfaction in pressure anesthesia. Instead of the preparation of Aristol and oxid of zinc that Dr. Leonard uses, I have used Eugenol and oxid of zinc with a little pinch of nitrate of silver crystals added before forming the paste. I should like to ask Dr. Leonard whether or not his paste has a setting effect. The Eugenol, oxid of zinc and nitrate of silver will set fairly hard and almost immediately on having saliva come in contact with it. It is very slow in setting until the saliva strikes it. Whether or not it is best to have this paste set is something to think about. The paste I have used in these pulp cavities does set and gets fairly hard and the permanent filling is then placed over that.

*Sidney Rauh, Cincinnati, Ohio:* Dr. Howe makes the absolute claim that in all cases of decay the infection goes much farther toward the pulp than the cavity of decay. I would not want to misquote him and I should like to be corrected if that statement is not true. So, unless there is a method of sterilizing this cavity (and I do not believe it has been demonstrated that carbolic acid, oil of cinnamon or oil of cloves or cassia are capable of so doing) I should see great danger in Dr. Leonard's procedure. I do not want to go on record as being opposed to this thing, but I would like Dr. Leonard to take up this line of thought, because if Dr. Howe's assertions are correct, there must be danger in the method.

In this talk of focal infection, it seems to me that the resistive power of the normal child is sufficient to allow an infected tooth to remain in the mouth under treatment until the orthodontist has been able at least to accomplish the first part of his work. I think that no experimental work has been done in young children to demonstrate that focal infections are so serious, as it has been in adults where infections have gone on for from twenty to forty years or more.

*John Oppie McCall, Buffalo, New York:* Dr. Rauh's last statement compels me to say that the resisting powers of most children are sufficient to permit the toleration of a certain amount of infection from various foci. They tolerate tonsils less than teeth, however. But that is not a generalization on which we can base our investigations as to what the resistance is. I have had a boy 7 years of age brought in (he had to be carried in, as he could not walk because of a serious condition of his heart), and we found numerous abscesses from deciduous teeth. He was taken to the hospital, and under gas anesthesia. I extracted every deciduous tooth in the child's

head. In one month he walked and skipped into my office, not normal as yet, but in a decidedly different condition than a month before. I have had other cases in which the resisting powers had been decided as being inadequate to cope with the infection, and extractions were recommended. I think that the method of Dr. Leonard has its use and value in many cases, but I should like dentists who practice this method to be sure, after consultation with the physician, that they are not retaining teeth in the mouth that should not be there.

*Dr. Leonard (closing):* Relative to Dr. Kelsey's remarks concerning the persisting vitality of these pulp stumps, of course, as I said in my paper, there is no means of determining that except by speculation, with our theory based on some of the demonstrated facts recognized at the present time—unless it be by experimenting and keeping accurate records of each case to determine just what the results of these operations are. But I will say, from a theoretical standpoint, if we have excised the pulp at a point sufficiently beyond the area of infection, extending the operation into a field that we have reason to believe is free from infection, and then have dressed these stumps with a surgical dressing that is soothing to the pulp itself, or at least is nonirritating to the pulp; if we can assume with a reasonable degree of certainty that it has not been infected (if it is infected it certainly would show inflammatory symptoms shortly), then what would cause the devitalization of these stumps? Pulps do not die without a cause; they die from bacterial invasion, or from mechanical or chemical irritation. Those are the only things I can think of that will cause the death of the pulp.

Dr. Rauh spoke of the extent of the infection in the pulp around its exposure in a permanent tooth. We can assume pretty confidently that the infection has extended to a certain degree into the pulp tissue, and not only so, but into the walls surrounding the pulp; and that very fact constitutes the weakness in the method of capping the pulp. It seems to me very much safer and better to go much farther and excise the pulp in the area that we have reason to believe is free from infection. If the infection has extended beyond the coronal portion, into the root canals, we already have a necrotic pulp. That would practically be true, I think. We have a necrotic pulp to begin with. We want to have a definitely vital pulp at the beginning.

As to pressure anesthesia, I feel perfectly confident myself that there is very little danger of forcing pathogenic organisms through the pulp into the canals, and up into the apical area. How would we do it? You may say that it goes into the blood vessels. How? It must go through the walls of the blood vessels and be filtered through the pulp tissues to the apical area. Suppose it went into the blood vessels. Why would it stop in the apical area? The blood vessels grow larger there all the time. It would go farther into the general circulation rather than stop in the apical area. Pathologists and bacteriologists who experiment a good deal with pathogenic organisms make their sterile fluids by passing tap water through a stone filter. The bacteria have certain physical qualities that prevent their passing through this filter. It seems to me that the pulp itself would make a much better filter than that. That is aside from the question, however, and in answer somewhat to some of the points made by the discussers, and also as a suggestion to someone who may care to experiment and work out a problem that has not been solved up to the present time. There is a wide belief among those who are considered authorities that these bacterial elements may pass through the pulp tissue and into the apical areas and infect the tissues there. I think what happens is that these bacterial elements that get into these areas after the extirpation of the pulp are taken there with instruments, usually during meddlesome and unnecessary after-treatment. You can hardly exclude the possibility of an infection by that route. It would favor an implantation of these bacterial elements at a very favorable place for their culture and would interfere with the success of the operation.

# THE PUBLIC SCHOOL HYGIENIST

By ALFRED C. FONES, D.D.S., Bridgeport, Connecticut

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BEFORE making a prophecy as to the final practical solution of the great problem of dental caries, the steps through which the Bridgeport demonstration has passed must be briefly stated that the reasons for our conclusions may be better understood.

The first educational course for hygienists was created in Bridgeport ten years ago, and the main purpose of training these specialists was to demonstrate the value of education and preventive treatments when applied to the mouths of masses of school children. The class also included young women who entered practice in private offices and now, after ten years of growth, the preventive work of dental hygienists in private dental offices is generally accepted to be of exceeding value to dentists and their patients. It is not the intention to touch in any way on the service of dental hygienists in private practice at this time except to mention the very satisfactory and efficient basis which prevails in this branch of work. Your attention, however, should be directed to the dental hygienists who did the pioneer work of inaugurating educational and preventive dental service for Bridgeport school children. Many of these original workers are still in the corps at the present time. When they began, in 1914, under the supervision of the board of health, the idea was so entirely new to the teachers and children that the program was confined to prophylactic treatments, mouth examinations and toothbrush drills. Thus, a concentrated effort was made to produce sanitary mouth conditions. Even if this idea of sanitation and cleanliness had not increased in scope, it, alone, would have materially improved the mouth conditions and prevented not a small percentage of dental caries. But as the hygienist became a more familiar figure in the schools, a gradual attempt was made to utilize some of her time in classroom education, particularly in talks along the lines of cleanliness, to reinforce the prophylactic treatments.

We were convinced, as our second year began and our experience increased, that a program which made sanitation its major consideration, even though it undoubtedly produced a noticeable improvement, was limited in its scope of prevention, for even the most rigid mouth cleanliness cannot counteract the effects of a faulty diet and poor hygiene beyond a certain point.

Still greater efforts were therefore made to increase the educational program, and it soon became evident that, if dental hygienists were to appear in the classrooms in somewhat the same capacity as teachers, a course in pedagogy was required. This had not been included in the pioneer class but was arranged for, and it was also recommended to the Columbia training school, which was just starting its course, that pedagogy should be included in the education of dental hygienists. Additional courses were also given to prepare for the classroom talks which, early in our work, included diet and general hygiene as well as mouth hygiene and health habits.

The furtherance of the educational program was handicapped because of the work being directed by the board of health. The board of education rightfully claimed that all the material used in classroom instruction must be approved by the superintendent, and it would not have been possible to enlarge this phase of the program and secure additional periods in the classroom unless supervised by the board of education. Mention should be made here that educational and preventive dental service can function best under board of education direction for several reasons, the most important being the elimination of the possibility of friction with the school authorities and all school employes, making possible the fulfillment of a comprehensive educational program. Since the work has been transferred to the board of education, the utmost cooperation has been received and increasing opportunities for broadening the scope of our program offered until, at the present time, the dental hygiene corps is employed under contract with the board of education as special teachers who are responsible for definite classroom instruction, to be mentioned later.

What was originally the "dental clinic" has now been absorbed into the school system as part of the Division of Health and Hygiene. A further proof of its complete absorption in the school curriculum is the interesting fact that certain dental requirements, along with other health standards, are required for promotion from one grade to another. It is felt that this is a very progressive step toward bringing parents and children to the realization that a sound body must accompany the educated brain.

During the nine years of this work, the corps has held together remarkably well, and although the personnel has increased considerably, many of the original corps are still with us and keenly interested in the developments of the past years. Personally, I feel that we should never have been successful in holding our workers over so many years if they had been confined to prophylactic treatments. The intelligent hygienist welcomes the opportunities for educational service, and her interest is stimulated by the variety in occupation.

During the past year, the superintendent of schools requested, as a special service, that the hygiene corps conduct the eye and ear tests—the eye tests being required by the state law. These tests had previously been given by the classroom teachers or the school nurses, or both, and it seemed an economy of time of these two to have the hygienist conduct the examination of the teeth, eyes and ears. The hygiene corps was instructed by eye and ear specialists in the most approved methods of conducting these tests, and this work was disposed of efficiently, with a minimum loss of time to the children and with no disturbance to the program of dental hygiene service.

My intimate relation for several years with the needs of school health service and with the agencies involved in providing such service had brought about the conviction that eventually the dental hygienist would be utilized for a broader health work, especially in an educational way, for teeth were but one of many common physical defects among school children, and that it might not be possible to concentrate the whole time of a special worker on the teeth alone. In 1919, in a paper read in Philadelphia and Chicago, I broached the subject of a health worker, no longer the dental hygienist but a public school hygienist, specially trained to further a general health program in an educational way, for the prevention of other remediable physical defects besides those found in the mouth. It was very gratifying to me to find that prominent educators concurred in this view, and looked on it as a solution to a truly preventive program for physical defects of school children. The gradual enlargement of the hygienists' sphere in the Bridgeport school system was largely

at the request of the school authorities, who saw ways of utilizing her services in a broader field and provided for the additional education and training which made an increased health service possible.

It has seemed necessary to recite this brief history and relate the present status of the hygienist in the Bridgeport schools in order that the background of experience which has prompted the following deductions may be understood. I am not in a position to present material that has been proved by scientific research; I can speak only with the authority of several years' experience and clinical observation of the physical conditions existing in a grammar school system of 22,000 children, and can recommend what my observations have led me to believe is a practical solution of certain health problems involved.

It seems to me that the public school health problem is divided, roughly, into two parts: (1) communicable diseases, such as measles, mumps, whooping cough, scarlet fever, diphtheria and chickenpox, and (2) physical defects, such as those of vision, hearing, nose, throat, teeth, skin, glands, chest, back, feet, height and weight.

The group of communicable diseases includes all of those which not only threaten the health of the individual child, but all with whom he comes in contact. These diseases require quick diagnosis, exclusion from school and a re-examination for entrance to school, and are definitely a problem for the medical nurse and medical inspector. In a large school system there is rarely a sufficient corps of nurses and physicians to do more than to cope with the communicable diseases. It is recognized that communicable disease must receive the first consideration of the medically trained worker, for it threatens the public health.

The second classification, which is listed as physical defects, includes all those deviations from the normal which handicap the child's mental and physical development. It is rare, indeed, for school health service to include the examination and recording of the physical defects of the entire school population, because the task is of such magnitude, and because communicable diseases must be recognized and controlled first.

From the attempts that have been made to record the defects among certain groups of children, statistics have been gathered that show a most regrettable condition. Ninety-seven per cent of school children have decayed teeth and malocclusion. Forty per cent have abnormal nose and throat conditions and posture defects; 20 per cent have affections or infections of the skin, while other defects occur in smaller percentages.

In large school systems, only a feeble attempt can usually be made to even discover and record these conditions, because of an inadequate examining corps, and only the most glaring defects can be pushed to the attention of the parents for remedial treatment. For some time it has been apparent that, with some well-planned additional education, the hygienist in public school work would be capable of making a normal diagnosis of school children and recording all deviations from the normal and referring these to the medical inspectors for final diagnosis. The valuable and expensive time of the trained physician could thus be saved, and indeed it is easily realized that there never will be available funds for large school systems to employ sufficient physicians to make individual examinations of each child. Neither does it seem feasible to add the physical examinations to the work of the medical nurse. Her training is such that she is indispensable in the care of those who are sick, particularly in communicable diseases, as has been previously noted.

It was interesting to find that, in the city of Detroit, the usual method of school medical inspection has been found to be inadequate, even with their large corps of medical nurses, and that a new plan is being tried out. The school teachers are making the preliminary examinations for physical defects, and the medical inspectors examine only the children referred to them by the teachers. There is no doubt but that this will greatly increase the number of children who can receive examination with resulting benefit. It does not seem probable that teachers will welcome the additional work thus entailed, for it must encroach on the time allotted to the pursuit of teaching. The teacher should be responsible for the health of the school child mainly in an educational capacity, for her special mission is the child mind and her special training does not include requisite instruction for physical examinations. The cooperation of the teacher is invaluable in health work, and she must have an intelligent conception of the health program. In fact, she is the one who must coordinate these various health activities for the child, but she should not be called on to take an active part in physical supervision. The outline for public school health which I would suggest embraces the following:

1. Medical inspectors and dentists
2. Public school nurses—for diagnosis and control of communicable diseases
3. Public school hygienists — for physical examinations, prophylactic treatments and special health education.
4. Public school teachers—for general cooperation and for emphasizing the health habits

Suppose that, by such a division of labor, communicable diseases could be controlled and that the physical defects could be discovered and tabulated, what is to be done about them? The first conclusion is that the majority of physical defects thus recorded would be remediable and that facilities are increasing everywhere in public clinics and dispensaries for their treatment. But it will not do to stop here. It is not that systematic examinations of school children provide interesting and valuable statistics; it is not that the defects noted are remediable and that attention is constantly centered on increasing facilities for their correction, but the great truth to be drawn from this record is that the majority of the defects are *preventable* and that their prevention is a matter of persistent education along three definite lines which seem to be the fundamental basis of general health as well as dental health: (1) proper food; (2) sanitation, and (3) health habits.

For several years we have analyzed the physical defects common in school children and observed the children individually as they sat in the hygienist's chair. Again and again we have asked ourselves why so many of these children have enlarged or diseased tonsils, pale and peaked appearance, flat chests and posture defects. Why are decayed teeth and malformed jaws so exceedingly common that parents look on them as natural occurrences? Did the cells in these little bodies deliberately build imperfect bone and tooth structure? It is a universal law that Nature strives always for perfection, and equally true that the tendency of the body cells, with their divine intelligence, would be to produce perfect tissues. Your house or your automobile cannot be better than the materials of which they are made. Your garden cannot produce a vegetable, fruit or flower that is more perfect than the seed and soil from which it is grown, and the bodies of your children will be no nearer perfection than the food elements from which they are constructed. The cells must have sixteen elements to produce and maintain a human being in health, and, incidentally, all other animals, all plants, and even productive soil require the same. If the body is deprived of even one of these sixteen elements, or if they cannot be obtained

in physiologic balance as Nature produces them, the result must be defective tissues, then disease and finally death.

The prospective mother who subsists largely on meat, boiled potatoes, white bread, white sugar, tea, coffee and pastries is robbing herself and her child of the prospect of a healthy body. Not one of these foods contains all the sixteen elements essential to life. They have been removed from the white flour and white sugar by refining, and from the potato by peeling, boiling and discarding the water. The nursing mother who continues the use of these foods cannot supply the necessary elements in breast milk unless her own tissues are robbed of them. The young baby, and the child as he grows older, who is fed on cream of wheat, farina, hominy, white rice, commercial oatmeal, pearled barley, and white bread is starving for the bone, blood, and tooth building materials which have been removed from all of these common articles of diet. Undoubtedly he will have poor teeth, for his mother's diet and his own have lacked calcium and phosphorus in physiologic balance necessary to perfect tooth structure. If the structure of the teeth is imperfect, what about his bony structure? What about his heart, lungs, kidneys, or even the endocrines? All of these tissues are dependent on the same blood stream for formation and development. How can one organ be more perfect than another when all require similar elements? It is practically certain that decayed teeth never exist as the only defect in an otherwise perfect body. The teeth are conspicuous, if defective, because they are so accessible for examination and study, but they can now be looked on as an index to the physical perfection or imperfection of the entire body. Soft and malformed teeth must be recognized as cardinal evidence of graver and more obscure defects, for it is hardly possible to believe that imperfect tooth structure is ever present as the only abnormality in an otherwise healthy body. Conversely, dense and perfectly formed teeth are indicators of normal physical development, with corresponding immunity to all disease. In the examination of 6,000 children at the Forsyth Infirmary, Pollini found that 11 per cent who were free from dental caries and malocclusion had been totally free from disease, and showed physical, mental and nutritional balance. The remaining 89 per cent cent showed the usual amount of caries and malocclusion, and all had been subject to infectious diseases. The hygienist and the dentist who are engaged in spreading education regarding the wholesome foods which produce strong teeth and prevent decay are, undoubtedly, also engaged in producing sound bodies, and in the prevention of all defects other than those found in the mouth, even though they may not realize it. The medical inspectors and nurses who are conducting nutrition classes for the prevention of malnutrition and anemia are also engaged in the prevention of dental caries and the production of strong teeth.

The organs and tissues of the body are so interrelated that all truly preventive health measures must benefit the body as a whole. This thought should be convincing of the close cooperation needed between medicine and dentistry, and locks dentistry definitely as a branch of medicine. We can no longer concentrate on the teeth as independent organs, but must enlarge our conception of the body as a whole, if mouth conditions are ever to be permanently bettered. And if the other physical defects are to be greatly lessened, or even eliminated, the truths concerning our food must be a matter of daily public school education for many years to come. The defects which will be present in this generation must have the best remedial treatment that can be secured, but persistent education regarding the use of natural foods cannot fail to increase the physical perfection of coming generations.

Added to the all important food education, it is necessary to teach the bene-

fits secured from sanitation—mouth cleanliness, with all that it implies, the importance of the bath, the cleanliness of drinking water, milk and all other foods, and of all utensils for handling food. Such material which is so familiar to the professional mind needs to be presented in form suitable and attractive to the child mind.

The third division mentioned for health education is the health habits, including correct posture, fresh air, exercise, sunlight, sufficient sleep and rest periods, thorough mastication, mental poise and, in fact, all those factors that are conducive to the stimulation of normal growth and to maintaining a high resistance to disease.

A really effective program for the prevention of dental caries and all other physical defects must combine these three phases of general health education, and such a program cannot be carried out in full by any of the known agencies working in public schools at this time.

The prophecy which I wish to make is that, in the next few years, a new worker, the public school hygienist, will be trained and in sufficient numbers to affect such health education for public school children.

In Connecticut we have been advocating the public school hygienist for the last four years, and the state board of education, with the state commissioner of education, after several conferences, introduced a bill in the legislature for the establishment of a department of public school hygienists in connection with a state normal training school for teachers. We are not discouraged by failing in the first attempts to secure the funds necessary for this purpose, but intend to pursue the matter at the next session of the legislature.

Briefly stated, it is planned to train the public school hygienist on the same basis as school teachers, and in the same institution for an equal period of time, that is, a two years' course—the hygienist to specialize on the child's body; the teacher, on his mind. The state will finance the course, as in the case of teachers, in return for which the graduates must engage in public school health work in Connecticut for at least two years after graduation.

The two years' course, in addition to the usual normal school courses in pedagogy and psychology, will include the special medical and dental education needed to produce a physical inspector, prophylactic operator and teacher of health and hygiene. It has been estimated that one public school hygienist could take the physical supervision and health education of the children allotted to ten school teachers.

The practical application would be as follows: The public school hygienist would be permanently located in a school and charged with the physical supervision of the children in ten classrooms. She would make a normal diagnosis of each child in these rooms and record all deviations from normal posture, vision, hearing, nose, throat, skin, glands, chests, back, feet, height, weight and teeth. In the case of the mouth, the prophylactic treatment and chart examinations would be given. The medical inspectors and dentists are thereby relieved from spending an enormous amount of time in sorting and classifying the normal children from the abnormal. The way is thus cleared for the concentration of the highly specialized workers on the final diagnosis, and when this is made it becomes the responsibility of the school hygienist to work through the child and the home for the correction of the defects. Once the physical defects which interfere with proper mental and physical development are recognized and recorded, the time is chiefly devoted to classroom education in dietetics, cleanliness (including toothbrush drills) and the health habits.

It can easily be imagined what such a system of physical education would do for the boys and girls of this country, and after all it is only through the con-

centration of our efforts on them that any great improvement in personal and public health can be secured.

The value of the increased health service that could be furnished by public school hygienists has still to be proved, but we have traveled a long way toward that goal, even though it has not yet been attained. Some of these things that were included in the regular school program during the past year were:

1. Examination of the eyes and ears of all 22,000 pupils in the Bridgeport grammar schools, with immediate practical utilization of the data secured by having all pupils with defective vision or hearing reseated in their classrooms to secure the most advantageous position
2. Examination of the mouths of 20,000 pupils, accompanied by prophylactic treatments
3. Toothbrush drills and education in mouth hygiene for more than 25,000 children
4. Education in proper foods and all phases of hygiene by means of 1,100 periods spent in actual classroom instruction, and attended by 43,800 children in all
5. A marked improvement in the mouth conditions of first-grade children just entering school, showing conclusively the effect on the homes of but nine years of public school education in mouth hygiene
6. A considerable reduction in the percentage of cavities per child, in the percentage of first permanent molars lost, and in the number of abscessed deciduous teeth
7. Compulsory health requirements, including dental, in all grades, as promotional requisites
8. Coordination of the classroom instruction in diet, with the instruction given in the domestic science kitchens. The domestic science course is compulsory for all girls beginning in the sixth grade, and is also a promotional requisite. To reinforce the instructions of the hygienists, this course has been radically revised and now specializes in the preparations of whole grains for cereals, bread and cookies, in the preparation and cooking of vegetables to retain the natural elements, and in the use of unrefined sweets, as honey, pure maple sugar, real molasses and dark brown sugar.

In addition to the last year's program, we hope for the coming school year to provide a special course for eighth-grade girls in baby feeding, including general principles of milk modification, care of bottles and nipples, and especially the preparation and uses of cereal dilutents, or gruels from whole grains, as well as vegetable broths and purees for infant feeding.

It seems most necessary to provide some practical course for girls who finish their schooling in the eighth grade. This course will be given in cooperation with the domestic science lessons. As a logical sequence we hope to provide compulsory courses in prenatal, infant and preschool diet for junior and senior high school girls. If spread over the last two years of high school, a rather detailed presentation of dietetics will be planned.

We believe that all health activities taking place under the roofs of the schools should be under the supervision of the boards of education. Therefore, the medical inspectors and medical nurses should form a part of this division of health and hygiene in order that these health activities may be properly coordinated.

## Discussion

*Guy S. Millberry, San Francisco, California:* I wonder if you who are familiar with his work have noted the evolutionary changes that have taken place in his plan proposed a number of years ago. Beginning with the problem of cleaning teeth, and mouth hygiene, gradually changing into an educational problem involving instruction to all of the children in all of the schools including the parochial schools, and finally extending into a broad health service—all this has grown out of his concept of mouth hygiene. It seems to me that it represents the progress we are making in this great health movement under

the auspices of the dental profession, which is being more widely recognized by the dental profession itself, and if not by them by other large groups of health workers whose interest is exhibited in the great educational health exhibit at this meeting.

Dr. Fones mentioned the training school for dental hygienists. It is not his intention, as I interpret it, to recommend changes in the curriculum. We who are concerned with the training of dental hygienists, and have the opportunity to come in contact with him, see the results of his work and we profit by this experience. We endeavor to train them to meet the needs of the public wherever they may be required. We are not directly concerned with retaining that phase of hygiene education in our universities, if the public school systems of the state, including the junior colleges and the normal schools, will provide it for the public. We are concerned, however, in seeing that the needs of the children are provided for, and we welcome Dr. Fones' advice in these matters.

The question of communicable disease and remediable defects is a disputable question between boards of health and boards of education. Boards of health who have in the past rested secure, as the medical profession has, on the treatment of disease are now concerned very materially with preventive medicine, and therefore have included in their problem the correction of remediable defects. They have had difficulty at times in gaining access to our public schools, sometimes through political friction, sometimes through social friction, but very largely because a group of people in this country are not directly concerned with medical service. They are opposed to many phases of medical service and therefore one term which Dr. Fones has used and which I have frequently condemned is the term "medical inspection," because of the psychologic effect of its use. If we could get away from that idea of inspection which always has a pertinent bearing on our personal affairs, it would be helpful. It does not make any difference whether we are traveling from France to America and we meet the inspector at the port in New York, or whether we disbelieve in the Volstead Act—an inspector seemingly interferes with our affairs. Whether it is my teeth or my body which shall be inspected by somebody else, it seems to encroach on my personal liberty. We do not like the words "inspector" or "inspection," and therefore out in the West we have substituted the term "cleanliness" and "hygiene" whenever we have spoken to people who are directly opposed to this plan, and we have won them over. Perhaps by persuasively expressing the truth rather than by publicly demanding the kinds of service we want, we will go farther, and the term "medical inspection" is one of the things which interferes very materially with the success of this movement in certain parts of the country.

Remediable defects are correctable, in part, educationally. We are coming to realize the importance of the first statement that Dr. Fones made, that proper food is so important in connection with this work, and if we can educate the people to eat the proper foods and take the proper exercise, we do not need to correct remediable defects through medical service; therefore it is distinctly a question of education. When we see the little children traveling along the street as we meet them every day with various types of physical defects, are we not immediately concerned with this question of education? The educational field is the greatest opportunity in our democracy and it offers the best for health activity.

When Dr. Fones speaks of sanitation we must bear in mind that if for no other reason than for esthetic reasons, sanitation and mouth hygiene are valuable. When people say that clean teeth do decay, we immediately respond with the suggestion that clean teeth are at least beautiful and therefore we are justified in advocating clean teeth even though a few of them do decay.

Very few communities, I dare say none, and very few persons even among us here would consider a child with defective teeth as a diseased child. If a child came into your offices or into your home and had decayed teeth and was lively and active and energetic, would you consider that child a diseased child? It is not a customary belief and yet all of us who know the after effects of those conditions realize quite fully that thirty or forty years perhaps may bring about a physical condition that is not remediable at that time, whereas it might have been corrected very early in youth through education, and therefore we must look on every child with decayed teeth as a diseased child and it is a part of our problem to prevent those conditions.

Dr. Fones has expressly quoted the difference between remediable conditions and preventable conditions and favored the latter. When we know how much can be done through prevention, why should we devote so much of our energy and time to the correction of these conditions and to reparative and restorative work? Even though we lose the type of professional activity that we now follow, would we not be better off and our children better off if we were following another kind of service in the prevention of dental disorders?

The two-year course for training public school hygienists has been mentioned as a possibility. Some people have objected to the brief course now required, stating that

girls cannot acquire the necessary preparation in that period. It does not follow that every girl or every woman who goes into this field of endeavor is limited to one or two years of training. She may have had a collegiate education before she undertook this work. Some high school principals and some trained nurses with experience as superintendents have followed this work in dental hygiene, and they are going to be the leaders in the movement. The character of the instruction is reflected very largely by the kind of training they get. Would you not prefer to have the children of your community receive instruction from a public school hygienist who has had intensive training for two years in this field of activity rather than have them receive instruction from the mother in a home who knows nothing about sanitation or hygiene? Even this limited training is far superior to the kinds of health instruction and health education that most of the children get today.

What part shall the dental profession play in this movement? We are indirectly concerned. Many of us have engaged in the work professionally, some in school work. We are concerned with the practice because this movement has developed out of dental practice, out of mouth hygiene and prophylaxis. Its success is largely dependent on the character of practice followed in the hygienist program. As citizens we are interested and can participate both in community and state legislation, first, by the inauguration of local ordinances, and, second, by the enactment of laws that will make it possible for us to establish in connection with our public school work the training of teachers in health education.

There is a gradual change throughout this entire country looking toward the interests of child welfare. It is the dominant thing in education today. We were especially favored in San Francisco in the latter part of June between the sessions of the American Medical Association and the sessions of the National Educational Association—a world health education conference—at which about 600 persons were present, representing all of the professions that are concerned with health education—one of the most potential audiences that I have ever seen—and they are carrying to the remote parts of this country and to other parts of the world (for sixteen different nations were represented at this conference) the messages that you are in a position to tell them. And therefore health education is the most important thing in our public school system today, because without health we are inefficient and incapable of carrying on the work that is expected of us in the future.

This universal interest in child welfare is a thing we ought to endorse. Dr. Fones has presented a plan which is universally recognized as being one of the most democratic that has ever yet been produced. We have the monumental dental clinic on one side which provides practically a gratuitous service—a wonderful work because its influence has spread world wide—and we have the great democratic movement on the other side, where the public schools are concerned and the children of tomorrow are being trained. The combination of these two is the most effective that we can produce, and largely through Dr. Fones' influence the territory of Hawaii, that little group of islands on the Pacific Coast, has undertaken to carry out that work on that dual plan. Mrs. Carter, the wife of the former governor, has placed an endowment of $1,000,000 for the erection of a monumental dental clinic to take care of the reparative service necessary and to train dental hygienists without cost. These hygienists are expected to go into the public schools and render a service. The territory of Hawaii provides salaries for their service. Mrs. Carter will not support the training of hygienists for private offices, only for public service. And because Dr. Fones was invited there to formulate a plan, the results have been manifested in the most liberal appropriation that has yet been made in any of the states or territories of the United States, namely, by an appropriation of $75,000 at the last session of the Hawaiian legislature to carry on this work in public school hygiene in the territory of Hawaii. I think that it is perhaps the best endorsement of the combined efforts that the American dental profession has made in this great movement, the establishment of a monumental clinic such as is manifested in the Forsyth Dental Infirmary and Rochester Dispensary, and the great public school plan that Dr. Fones has advocated. We are indeed fortunate to have among us the types of men who represent these ideals, to help us carry on this great work for the children.

# THE RELATIONSHIP BETWEEN THE MANUFACTURER AND THE DENTIST

By C. N. JOHNSON, D.D.S., Chicago, Illinois

(Read before the annual meeting of the employees of the Ritter Dental Manufacturing Company, Rochester, New York, December 13, 1923)

THE success of an institution, whether it be a business or an association, or any kind of an enterprise whatsoever, is dependent largely on confidence and cooperation. The good-will of those with whom we come in contact in the various activities of life is also an essential factor in bringing about success. If there were more universal good-will in the world, the machinery of our lives would move more smoothly, and we would be happier and more successful. To bring about good-will, the thing most needful is a better understanding. Much of the friction of life is due to the fact that men do not understand each other. The failure of one man to see the other man's point of view is accountable for most of the disharmony that mars our intercourse one with another.

How important it is, then, that the manufacturing interests and the dental profession should be brought together in the closest possible community of sentiment and understanding! In the ultimate analysis, the interests of each are identical. This has not been sufficiently recognized by either party, and it has resulted in some lines of cleavage which have not worked for the welfare of all concerned.

The essential function of both the dental supply man and the dentist is to see that the people get the best possible dental service. The dentist would be well nigh helpless to render this service without the facilities provided for him by the manufacturer, and, of course, the manufacturer and the people are both dependent on the dentist to see that the products supplied by the dealer are properly administered for the welfare of the people. There is a mutual dependency that should be recognized to a fuller extent than it has in the past, and in this connection there has been a constant conviction in my mind that the profession generally has not often enough acknowledged its great debt to the manufacturer for the untiring energy and ingenuity he has displayed in furnishing us with the facilities for making our service more effective and less irksome. It is a pleasure for me, as a practitioner, here and now to pay my tribute to the many splendid men in the manufacturing field who have devoted the best energy of their lives to the invention and perfection of instruments, apparatus and accessories for the daily use of the dentist. The ingeniousness, utility and artistic beauty of some of these products have never ceased to compel my admiration, and I deem it a most fortunate circumstance which has given me the opportunity and the privilege of making

this public acknowledgment. There are very few practitioners who, when they reach out to grasp the handpiece of an electric engine, or who turn on the water of a fountain cuspidor, or who adjust a chair to any requirement of the case, ever stop to think of the manifold processes which were necessary to bring this mechanism to its present state of perfection. If they have paid the price of so many dollars for their equipment, they do not seem to acknowledge any further obligation to the manufacturer. It might be of mutual benefit if they would at times try to visualize all the various steps from the first crude mechanism in the mind of the inventor on down through the numberless refinements to the ultimate thing of beauty and utility as we see it.

It would, I am sure, put new courage and heart in the dealer if, at times, the practitioner would give expression to his admiration of the achievements of the manufacturer and if he would make some note of the long road of difficulty and discouragement over which the latter has had to travel in order to reach his present status. We are all human, and, after all, it is a rather dull process merely to turn over goods and receive dollars for them, with no further amenities to the transaction. In our professional work, if patients contented themselves with simply paying their bills and making no comment on the efforts we had put forth on their behalf, it would rob professional life of half its attraction. No man ever died of too much encouragement, and dentists need therefore have no fear of killing off their friends, the manufacturers, with a little of this commodity.

And now that I find myself in this contrite mood, I may make further acknowledgment of the fact that dealers have not always found professional men possessed of a high degree of business sagacity. Their ideas of business procedure have doubtless often been a sore trial to those who have of necessity been brought into such an intimate relationship with them as have the manufacturers. This has so impressed the latter that they have in some instances sought to instruct the profession along business lines, and up to a certain point this is very commendable. It will do no harm, and may do much good, to instruct dentists as to the ordinary routine of the business world—the collection of accounts, the payment of bills, promptness, system, orderliness, and the just recognition of a business obligation—all of this is constructive and praiseworthy. Between the dealer and the dentist, there can be no question as to the value of this kind of instruction.

But there is one particular in which it has seemed to some of the profession that the dealer has unwittingly made a mistake. Quite naturally he has argued that, if the dentist needed instruction regarding his business dealings with the manufacturer, he also needed it with reference to his dealings with patients, and forthwith the dealer has sought to impart this kind of instruction. With the best of intention the dealer has overlooked two things: his legitimate function in relation to the profession, and the fundamental fact that the practice of a profession can never be reduced to the hard and fast business rules of a strictly commercial pursuit. If this had been attempted from the earliest days of dentistry till now, it is safe to assert that we would today have had no profession at all, but merely a body of mechanics who were inserting so many grains of gold or amalgam at so much per grain, or so many artificial teeth at so much per tooth.

No complaint whatever is made here of the intent of some of our dealers to better the condition of practitioners through the agencies referred to. They saw a need and they sought to fill it, and it was not to be expected that they could see the matter from the profession's point of view. The alacrity with which some members of the profession sought to accept their teaching along these lines misled them to believe that the profession generally needed this kind of instruction and welcomed it. It was the most natural mistake in the world, but that it was a mistake is evidenced by the frequent comments we hear against it wherever representative dentists congregate.

Let this one fundamental fact sink into the consciousness of both the dealers and the dentists—that no line of business procedure can ever be permanently successful which does not take into account the welfare of both parties to every transaction. This is basic in principle. When dentists are taught that they should demand a certain number of dollars for every hour they practice, and this is all figured out on what seems a perfectly legitimate estimate, there is only one-half the story told. We may sit down and with pencil and paper prove that it is necessary for us to get a certain recompense for the time expanded; we may build up in our consciousness the conviction that we are entitled to a just compensation—all of which is logical and irrefutable—but always and forever there is some one else at the other end of the line. There is the patient. And that patient cannot be ignored. In all of the business instruction to dentists that I have read I have seen almost no reference to the patient's point of view or to the patient's reaction to a certain suggested line of procedure. And may it be said in passing that while some men have improved their financial standing by introducing new methods of business management, many others have ruined their prospects in the attempt to carry out some of the suggested methods. Compensation for professional service can never be determined by rule of thumb or figured with pencil and paper. It must be regulated as well by the point of view of the patient as by that of the dentist, and unless the patient can be convinced that it is just and equitable, he will not long remain a patient.

This last remark naturally brings up the subject of salesmanship. I do not quite like the term "salesmanship" when applied to professional life, and yet I suppose, in a certain sense, we are all salesmen. But salesmanship in professional life is vastly different from salesmanship in commercial life, and it should proceed along different lines. Salesmanship in business relates to such a presentation of the good qualities of any article or commodity that the buyer is sufficiently impressed to want to acquire it. Salesmanship in professional life relates to the power of impressing people with the value of the service we are rendering, and with the fact that it would be to their advantage to have this service. As we are the ones who are rendering this service, it would be manifestly immodest and lacking in good taste for us to magnify to the patient the particular value of the particular service we are to render. The only way we can successfully impress people with the value of dental service and make them want this service is by a quiet, kindly, gentlemanly, painstaking performance of all operations committed to our care, without a word of prating about our own prestige. It is different entirely from extolling the vir-

tues of a certain make of gold or a certain dental unit. Vague as this may seem in the minds of practical salesmen such as yourself, I can confidently assure you, on the basis of a somewhat extended experience among professional men, that this is the most certain way to succeed in the practice of a profession. There are, of course, many minor details necessary in conducting a successful dental practice, but the fundamental basis is the character of the service and the manner of administering it. It will thus be seen how very far afield have been some of the methods advocated in the recent past for acquiring and maintaining a professional practice.

Speaking on the general subject of salesmanship, it would seem presumptuous on my part to offer any suggestions to a body of experienced salesmen such as are assembled here. And yet I trust that I may be pardoned if I make a few observations, based on experience, as I have looked on from the outside and seen salesmanship conducted.

Successful salesmanship relates, first, to the establishment on the part of the salesman of a perfect confidence between himself and the possible purchaser. The prime requisite for salesmanship is absolute sincerity of purpose, and not mere glibness of tongue. The prospective salesman should assure himself, as a premise, that he has full faith in the product he is about to sell. If he cannot do this, it would be better for him not to attempt that particular job, because sooner or later his prospects will founder on the rocks. No man can go on indefinitely misrepresenting or misinterpreting his true convictions and achieve a successful career, or be of real service to his house. Loyalty to the concern and confidence in its policy and its products must be the keynote of every salesman's creed. He must look on the welfare of the house not only in form but in fact as his particular welfare, and must assume the attitude that whatever injures the reputation of the house injures him, and that whatever reflects on him reflects on the house.

He should be a keen student of the industry he is representing and know every angle of it like an open book, and, what is fully as essential, he should make himself familiar with the needs—the real needs—of the people who are to be his patrons. This one fundamental fact requires reiteration: no system of salesmanship can ever be permanently successful which does not take into account the welfare of the purchaser as well as that of the seller. The really successful sale is the one which leaves the buyer permanently pleased with his purchase, and thankful that he was given the opportunity to buy. The thing that counts for most is the attitude of mind of the purchaser during the days and weeks and months following his purchase, rather than during that one hypnotic moment when the persuasive and ready-witted salesman has induced him to buy.

The psychology of salesmanship has been the subject of many able articles, most of which I confess I have never read, and my audience is probably more familiar with it than I. But I am going to venture one opinion: the most successful and serviceable psychology that can be employed is the one which will enable every salesman to look his customer fully in the face year after year with the firm conviction that he has never in any way misled him or advised him against his real interests. The best of the world's business is conducted on confidence, and confidence is founded not on ingenious argument but

on demonstration. To be able to present the most favorable side of any article is, of course, necessary, but it is also necessary for the salesman to recognize the limitation of an article if it has one, and to protect his customer against that limitation by explaining, correcting or overcoming it. In some way he must plan so that he may meet that customer a month hence, or a year hence, with the utmost assurance that he will be cordially received.

A successful business was never founded on contention, and it is the duty of the salesman to stand between his house and the customer in harmonizing any differences which may arise. To this end, the salesman should be an advisor to the house, and should be keenly alert in making suggestions which may work to the benefit of the organization. He may discover a faulty mechanism in a product which the man in the shop has never detected, and which he has no means of detecting until the product has been subjected to continued practical service. Machinery does not always work out according to the rule of thumb, any more than do our ethical and moral codes. In other words, there is always room for improvement, and the house, I am sure, will be grateful for suggestions which tend to make its products more perfect.

There is one tendency in salesmanship which, I am pleased to note, is apparently passing away, and that is the habit of disparaging the products of other concerns. This was formerly the sheet anchor of many a salesman's policy, but it is so fundamentally wrong that it has invariably proved a boomerang. It is safe to assert that no successful business was ever built up by trying to tear another business down; in other words, we can not climb to true success over the wrecks of others. It would seem that in the splendid science of salesmanship there is a growing tendency toward higher ideals and loftier motives, and it is a very healthy sign of the times when an organization such as the Ritter Dental Manufacturing Company brings together in annual convention its large force of employees for the consideration of subjects calculated to make their work more uniform and their service more efficient. It gives me pleasure to offer my congratulations on the conception and carrying out of this idea, and to express my appreciation for the courtesy extended to me in the invitation to address you. I can only hope that similar conferences in the future may result in a better understanding between the dental dealers and the profession, to the end that the people whom we conjointly serve may be cared for with increasing efficiency.

# IMPORTANT POINTS THE GENERAL PRACTITIONER SHOULD KNOW IN ORDER TO PREVENT DENTAL IRREGULARITIES

By MILDRED W. DICKERSON, D.D.S., Washington, D. C.

(Read before the American Dental Association, Cleveland, Ohio, September 10-14, 1923)

WE HEAR a lot about preventive dentistry these days, and much has been written relative to the diagnosis and prognosis of dental irregularities. My résumé of dental irregularities includes (1) caries of the teeth leading to the death of pulps, followed by an infection of the periapical tissues; (2) all affections of the investing structures of the teeth, tending toward complete disintegration of the periodontium; and (3) the various types of malocclusion with their attendant evils.

Although a great field for the prevention of dental irregularities is opening up through the work on nutrition and dietary control, and although the endocrinologist is striving to prove that many dental irregularities, including immunity or susceptibility to dental caries, depend on the endocrine balance, the general practitioner will have to continue and redouble his efforts in the use of the knowledge he now possesses.

McCollum says, "As a profession we have ignored the developmental factor as the one that is operative in preventive dentistry. There is one way back to better physical development and that is the most fundamental of all, namely, to build up a normal, physical structure, and that can be done only through proper diet. The child of school age is beyond the reach of help in this respect. His teeth are already formed. This preventive dentistry proposition is largely one of prenatal life and infancy."

We should all inform ourselves as to the practical research work in nutrition that is being done at the present time, and make use of it in giving our patients, especially parents, the opportunity of learning all that we know concerning the question of diet and the relation it bears to the development and maintenance of healthy teeth as well as healthy bodies. When we can convince the parents of the necessity of placing their children in the dentist's care during babyhood, the period from birth to the completion of the primary dentition, there will be the greatest possibilities for preventing dental irregularities. Knowledge in regard to diet, if put into practice during this period, will be of great value in the development of normal, healthy teeth, because, with the exception of the permanent first molars and central incisors, all of the teeth of the secondary dentition are formed after the child is 2 years of age.

Oral prophylaxis is the prevention of disease in the mouth. The practice of oral prophylaxis includes a complete diagnosis of mouth conditions and all procedures designed to prevent disease,

whether they be instructive, mechanical, surgical, medicinal or orthodontic. Diagnosis is the most important thing in oral prophylaxis. Many dental irregularities could have been prevented had a careful diagnosis been made of mouth conditions during babyhood. At that time the dentist should observe the hygienic condition, any mucous membrane lesions, the frenum, and whether the teeth are erupting normally. Diagnosis should include a recital of the family history to disclose inherited tendencies and predispositions to certain diseases. Careful inquiry should be made as to the habits of the child. Habits such as sucking the thumb, fingers, tongue or lip, if continued until the eruption of the permanent incisors, frequently cause malocclusion. If these habits are corrected before the loss of the deciduous teeth, there usually will be no ill effects. If the child breathes habitually through his mouth, parents should be warned that mouth breathing is one of the most potent causes of malocclusion, and the advisability of an examination by a rhinologist should be suggested. Mouth breathing is most prevalent between the ages of 3 and 14, and is usually due to pathologic conditions, adenoids or some other nasal obstruction.

The great necessity for unceasing watchfulness and care on the part of the dentist during the periods of babyhood, childhood and adolescence must be impressed on parents with the view of enlisting their interest and cooperation. Patients should return for dental observation and oral prophylactic treatments at regular intervals of not more than three months, and accurate records of each case should be kept.

Many years ago, Dr. Edward Angle called the attention of the profession to a well-known physiologic law—that the use of an organ or muscle tends to stimulate its growth and normal development, while disuse tends toward lack of development. He pointed out how many irregularities in the development of the jaws and the alinement of the teeth could be traced to disturbances in the functions of the teeth themselves, or other oral organs as the lips, cheeks and tongue. Malocclusion resulting from premature loss of teeth or from habits which disturb the functions of muscular pressure are common illustrations of the application of this law. More recently, periodontists have recognized the importance of this law in its application to their work. Stillman and McCall[1] state: "The essential problem of oral prophylaxis is to secure and maintain normal function. Normal function preserves the health of the oral tissues by stimulating the circulation of the vascular structures and by maintaining the cleanliness of the teeth."

The foundation of cleanliness is normal function, and normal function in turn depends largely on the normal occlusal relations of the teeth. Normal occlusion provides for the natural cleansing of the teeth by the excursion of food over them in the act of mastication, and for the stimulation of the blood supply in the gingival tissue by the friction of food passing over it. The compression of the pericementum and cemental gingiva in the act of mastication stimulates their circulation, maintains them in a state of health and guards against infection by thus providing for their nourishment. When irregularities in occlusion are present, or when teeth are missing, we commonly find the natural cleansing process prevented, the difficulties of artificial cleaning increased, and debris readily accumulating about the teeth thus affected. We also observe an incipient gingivitis, due to the trauma from the impaction of food on the gingival tissue, in con-

1. Stillman and McCall: Clinical Periodontia.

trast to the normal stimulation of the blood supply when the occlusion is normal.

Hence, normal occlusion is of paramount importance to every person, and of more importance than treating irregularities is their prevention. The most effective means of preventing malocclusion is close watchfulness and care of the deciduous teeth. Much can be accomplished through the prevention and correction of certain habits, which through a disturbance of muscular function cause a derangement in the development of the jaws. Observation should be made of the general shape and width of the dental arches, and where there is a lack of development from insufficient mastication, hard and fibrous foods should be added to the diet and thorough mastication required. This will do much to stimulate development of the arches.

No time can be more profitably and wisely spent than in helping to educate mothers in the care of the deciduous teeth. There is no time in a child's life when it is safe to neglect the thorough cleansing of his mouth, and after the eruption of the deciduous teeth, systematic care with the aid of toothbrushes is indicated. The dentist should be an enthusiastic and patient teacher, giving strict attention to minor details. An actual demonstration of the use of the brush in the child's mouth will be of much benefit to the mother and child. The age at which a child can brush his own teeth varies with the child, but as soon as he can master a simple, definite technic, he should be allowed to perform this service for himself. The mother should supervise the child's brushing and be able to determine by examination whether he is really accomplishing the desired result—a clean mouth. A child should brush his teeth after each time food is taken, to prevent collection of media on which bacteria thrive.

Of next importance to the patient's daily personal care is the oral prophylactic treatment by the dentist. Oral prophylactic treatment has been defined as "a periodic and systematic technical procedure designed to prevent oral disease." In the treatment of the young it aims to prevent caries and periodontal disease by the surgical removal of bacterial colonies and irritating foreign material from the tooth surfaces, followed by thorough polishing. This includes the polishing down of any rough fillings with overhanging margins. These treatments greatly aid patients in the care of their mouths and stimulate their efforts. Prophylactic treatments should be given at regular intervals and thus serve to bring the patient periodically under the observation of the dentist. This will give opportunity for the discovery of caries in its incipiency. The frequency of the treatments will depend largely on the thoroughness of daily care and on the susceptibility of the patient's teeth to caries.

When a child shows signs of caries, susceptible areas such as pits and sulci on any of the surfaces of deciduous teeth should be treated with silver nitrate. Silver nitrate is very efficacious in the control of caries, when properly reduced under fillings. Restorations in the teeth should by all means restore their function. When deciduous or permanent teeth require proximal fillings, these fillings should always restore the surface contour and mesiodistal width of the teeth, both for the protection of the interproximal gingiva and for the stimulation of the development of the jaw. For the latter reason, it is most necessary that such proximal fillings be made of amalgam or copper amalgam so that the normal contact of the restoration will remain permanent and the normal space be maintained. Cements are not sufficiently permanent. Where it is at all possible, the principle of extension for prevention should be observed in making restorations. Root-canal work should

not be attempted in deciduous teeth unless it can be done under the same aseptic conditions as it is in the permanent teeth, and then only in single-rooted teeth. An abscess on a deciduous tooth indicates its extraction, and when a deciduous tooth has been prematurely lost, the space should be maintained by some mechanical device until the permanent tooth erupts. If a child loses a permanent tooth, or if permanent teeth are congenitally missing, the case should be referred to an orthodontist. Permanent teeth should never be extracted to correct malocclusion, except on the advice of an orthodontist.

It would be well, as a matter of routine practice, to have radiographs of the entire mouth taken when the child is about 6 years of age to determine whether the normal complement of teeth is present, and reveal such irregularities as supernumerary and malposed teeth. The radiograph also indicates when a deciduous tooth, by its over-long retention, is interfering with the eruption of its successor.

The first permanent molar, during the period between its appearance in the mouth and when it reaches its normal occlusal relations, will be found to readily accumulate debris, owing to absence of the normal function of mastication. This condition largely explains the frequency of caries in this tooth.

The occlusal surfaces of many first molars could be carried through this critical period free from caries by the following treatment: The occlusal surfaces are first thoroughly cleansed and dried; the sulci and pits are then treated with an ammoniacal solution of silver nitrate, and after a few minutes reduced with eugenol. In from three to five minutes they are dried thoroughly again and some good light-colored cement is allowed to flow over the surface. The cement is covered with a piece of rubber cloth and a small pellet of moist cotton is pressed on the cloth, driving the cement into the sulci. The cement is allowed to set under pressure. The rubber will come away leaving the cement smooth and only in the sulci. Any excess should be cut away so that it will not interfere with normal occlusion when the tooth is fully erupted. If the patient has regular prophylactic treatments, it is possible to watch these teeth, renewing the cement when necessary.

While the normal use of the teeth in mastication is the natural method of cleansing them and of stimulating the circulation in the periodontium, the diet of civilized peoples is such that the function of mastication must be supplemented by some artificial means. The toothbrush is the best agent for the purpose, and the method of using it should accomplish both objects, that is, the thorough cleansing of all tooth surfaces and also the stimulation of the circulation. There are certain requirements of the toothbrush which have been agreed on by those who have made a special study of oral prophylaxis, and they should be more generally adopted by the profession. The brush head should be small, not more than 1¼ inches in length and about ⅜ of an inch in width. The bristles should be fairly stiff and not more than ⅜ of an inch in length. The brushing surface should have no long tufts but be fairly flat from heel to toe.

If the public is to be duly impressed with our teaching, it is imperative that the profession come to an agreement on certain points, so that patients will not be given conflicting instructions by different dentists. We should have more uniformity and simplicity in our teaching, and all instructions should be quite definite. We all ought to know that the gums should be brushed toward the teeth only, and that so-called "up and down" brushing is fully as harmful as brushing mesiodistally. Yet frequently patients say that they have been taught to brush their teeth up and down, and when asked to give a demonstration, they do just that, forcing the gums away from the teeth at every stroke. This is true be-

cause many dentists give careless and indifferent instructions with no thought as to the consequences. There are many people other than dentists giving instructions in the art of brushing the teeth. The oral hygienists, school nurses, social workers and in some cases school teachers are trying to do their part in this work. Since it is so essential that correct technic of brushing the teeth be adopted, it is important that the dental profession take the lead in the matter of education along these lines. We could do much toward the adoption of a universal method for teaching children. In view of the fact that the old and incorrect mesiodistal method of brushing was so universally used, it would seem that we should at the present time have a correct method that would be just as universally used. Instructions should be so explicit and simple that no confusion of ideas would occur in the mind of the public with regard to the method. The cleansing powers of the brush itself should be emphasized, as well as the amount of time and number of times a day that it should be used.

It is the expressed opinion of many of the best minds of the profession that medicated dentifrices and mouth washes have no therapeutic value and their use as such is wholly unwarranted. The public should be so enlightened. It is impossible to "sterilize the oral cavity" with any antiseptic in the strength in which it can be employed with safety in the mouth. A brief explanation of the factors which enter into the action of antiseptics and disinfectants will reveal the fallacy of the claims made for most commercial preparations. In giving advice, then, in regard to dentifrices, we should be agreed that a dentifrice is used only for the cleansing and polishing of the teeth.

Prior to the eruption of the permanent teeth, it would be well for the child in the daily care of his teeth to use water alone or a little table salt sprinkled on the brush. The enamel of the newly erupted permanent teeth is naturally rough, so the use once a day of a fine polishing agent, preferably a powder, is indicated. Since so many dentifrices are really harmful because they contain either injurious drugs or coarse abrasives or both, we should be guided in the selection of harmless and efficient dentifrices by the reports of the research work done on dentifrices in the laboratories of the various institutions of dental education.

The important part that a "clean mouth" plays in preventing dental irregularities in children's mouths will be understood when we realize that the only means we have for lessening the number of bacteria in the mouth is the eradication and removal of the media on which they thrive and the bacteria themselves. If we can retain the full complement of teeth in correct alinement, and if the placing of restorations has been done with a view to maintaining the health of the investing tissues and normal occlusion, we will have in a large measure prevented traumatic occlusion, one of the principal causes of periodontal disease and the loosening and loss of many so-called "sound" teeth in later life. The general practitioner's greatest opportunity for preventing dental irregularities lies in putting into practice the knowledge now in his possession regarding the prevention of dental lesions in the mouths of children.

## Discussion

*C. N. Johnson, Chicago, Illinois:* This subject, as I sum it up, resolves itself into a question of prevention. Prevention is the keynote of dentistry today. It is the basis of all of the future progress that you and I are going to make. Unfortunately, we cannot have much influence with our ancestors. It has been said that if you wanted to make a decent citizen, you must go back to the grandfather or great-grandfather or even farther than that. We have not much influence with them, but in the practice of dentistry, we have a definite field of work in the patients that are brought to us, and those patients come to us today earlier than formerly. The patients cannot be brought to us too early for the most effective service.

The prevention of disease in the mouth is a problem of watchfulness and intelligent care, not only the care that the operator gives the patient, but more particularly the care that the patients receive in the home. I am in the habit of telling people that the service we render is not nearly so important as the daily service that they give their mouths themselves. We must insist on that. We must supervise these patients and see whether or not they are carrying out our instructions. It is a matter of education, and people are becoming more amenable to education. There never was a time before when I had the profound optimism as to the future of our profession that I have today.

This question of diet is a most important question, but it is one that is going to take a long time to solve. It is the basis of success not only in the practice of dentistry, but in the practice of medicine. I heard this tribute given to one of our members, Dr. Percy Howe of Boston: "Percy Howe has saved my life. There is no question about it." He saved his life by prescribing a certain diet. This gentleman had been treated presumably in the most scientific manner by some of the most eminent medical men, and was no better. It is not always as simple as that, however. There is one thing in connection with this matter of diet that must be remembered, and that is, personal equation. We cannot reduce it down to a definite diet and say that that diet is going to fit all persons, because it will not, any more than the administration of a certain drug is going to have the same effect on two different people. I do not know whether it is fortunate or not, but it is true, however, that we are all organized somewhat differently. At the same time, there is a basis for rational diet and we should give the subject of nutrition intelligent study.

This matter of diet must be considered in connection with the prevention of dental diseases. It will take a long time to come to a definite agreement as to what is the best diet for the majority of people, and that is only a small part of the problem. The great problem lies beyond that—the problem of making the people conform to that diet. We will first have to educate the people to these things. It is a big problem, but we are going to solve it as we have solved other difficult things in the profession. The general practitioner gets hold of these patients before the specialist does. It is the duty of the general practitioner to keep a close supervision over every little patient that comes into his office, and to study that patient not with the mere routine of putting filling materials in cavities in teeth, and letting it go at that. The conditions that surround our operations are often more important than the operations themselves. For many years in the profession we forgot there were such things as supporting structures of the teeth, and put fillings in teeth that hadn't sufficient foundation. We overlooked the conditions.

I have listened to the subject-matter this afternoon with a good deal of interest. I am going to presume, and I hope I may be forgiven, for making just one remark on this question of nomenclature. I have heard in this room this afternoon such terms used as the "six-year molars." I hope we are going to eliminate from our nomenclature misleading terms of that kind. I am not criticizing the speaker who used those terms, because they have been in such general use so long that it has become a matter of habit to use them, but we are now working very hard in this matter of nomenclature, and we are trying to crystallize it so that it shall be definite, so that it shall be scientific, and so that it will not be misunderstood even by the laity. I want to eliminate such terms as the "six-year molars," the "twelve-year molars," the "wisdom tooth," and I want, above all things, to get that term "eye tooth" out of our literature.

These reports on nomenclature are published each year, and I want you to study them. I don't know what a scientific body such as the American Association for the Advancement of Science would think of us if they came in and listened to some of our discussions. They formulated a nomenclature years ago in their association. We are trying to do the same thing now, and I trust our members will all cooperate, and that everyone who prepares a paper and everyone who discusses a paper will try to use those terms that are in accordance with the most recent nomenclature. We have not perfected our nomenclature; we are only working on it to that end. We ask your cooperation.

# DENTAL RESEARCH

**By DEPARTMENT OF COMMERCE**

BUREAU OF STANDARDS
WASHINGTON
December 18, 1923

*Dr. Otto U. King, Secretary,*
*American Dental Association,*
*5 No. Wabash Ave.,*
*Chicago, Ill.*

*Subject: Dental Research*

*Dear Sir:*

*1. The enclosed outline of this Bureau's program of dental research is sent for your information and for the information of those of your Association who may be interested in the work.*

*2. The outline is being mailed to those whose names have appeared in the Journal during the year 1922-23. Unquestionably there are many whose names have not appeared during this period, who are well qualified in this science. The Bureau will be pleased to have you put this outline before the members of the Association through the January or February issue of the Journal of the American Dental Association, asking them for information and suggestions on the problems.*

*3. Your personal experiences and advice will be welcomed.*

*Respectfully,*
*(Signed) George K. Burgess,*
*Director.*

*Communication B 714*

DENTAL RESEARCH

A research on the physical properties of dental materials as related to prosthodontia and orthodontia is now in progress in this Bureau. Apparatus and special equipment have been and are being assembled for the work. Tests are being made on the fundamental physical properties, such as: temperature expansivity, distortions due to time or temperature or both, wax eliminaton, casting technique, elastic properties and heat treatment of gold alloys. This work is being carried on as a cooperative research in conjunction with the Weinstein Research Laboratories. The Bureau is in complete control, however, in directing the work and publishing the results.

Some data and information have been secured from the text books and journals of the professon. It is needless to say that many of these articles are contradictory. To facilitate the continuance and completion of the research we wish to receive additional suggestions from a number of those actively seeking the advancement of the science.

With this idea in mind the Bureau will be pleasd to have comments upon the relative importance of the subjects in the accompanying outline indicating those calling for special attention and those of little importance, adding to the list wherever necessary. Replies should also give the results of any tests you may have made on these subjects, and especially any experiences you have noted in your practice.

Upon receipt of your reply, your name will be placed upon our list for such further cooperation as may be warranted

by your interest in the matter, and for whatever special or complete reports may be issued in connection with this investigation.

OUTLINE OF RESEARCH

*I. Pattern Waxes*

a. Working temperatures
b. Investing temperatures
c. Dimensional changes
d. Compensations for other defects
e. Elimination from mold
1. Burning out partially. 2. Burning out completely. 3. Elimination by boiling and heating, etc.
f. Subsequent surface condition of molds

*II. Investments*

a. Ratio of plaster, silica, etc.
b. Mixing technique
c. Dimensional changes
1. Due to time 2. Due to temperature
d. Strength (ultimate compression)
1. Cold. 2. Hot.
e. Porosity

*III. Gold Alloys for Casting*

a. Chemical composition
b. Micrographic studies
c. Casting technique and equipment
d. Melting ranges
e. Effect upon surface of molds
f. Casting shrinkage and other defects
g. Elastic properties for clasps, etc.
1. Deflection under stress. 2. Set. 3. Tensile strength and hardness. 4. Resiliency values.
h. Life tests (repeat stress) for flexure of cast clasps, etc.
i. Heat treatment of castings

*IV. Gold Alloys (wrought) for Prosthodontia and Orthodontia*

a. Chemical composition
b. Micrographic studies
c. Melting ranges
d. Annealing temperatures and methods
e. Solders
f. Elastic properties for clasps, arches, springs, etc.
1. Deflection under stress. 2. Set. 3. Tensile strength and hardness. 4. Resiliency values.
g. Life tests (repeat stress) for flexure
h. Heat treatment of completed appliances

*V. Impression and Cast Materials*

Including Plaster of Paris, Modeling Compound, Wax, Artificial Stone, Fusible Metal, etc.

# PERIODONTAL DISEASES AND THEIR TREATMENT FROM THE VIEWPOINT OF OPERATIVE DENTISTRY

By FREDERICK MERRIFIELD, D.D.S., Chicago, Illinois

(Read before the American Dental Association, Cleveland, Ohio, September 10-14, 1923)

IN bringing to your attention some known facts pertaining to diseases of the periodontal tissues, it will be my aim to associate definitely their close relationship to operative dentistry, and to prove that, without a knowledge of those conditions which demand remedy by means of the greatest skill in operative procedures, all attempts to correct and control lesions of the investing tissues must, of necessity, fail.

In speaking of periodontal diseases, I shall refer particularly to that condition, so prevalent among us, and having so tragic an ending, which, beginning always with a gingivitis, ends with the destruction of fibrous attachment of the tooth to its alveolus. This condition is known generally by that much abused, indifferently used and inappropriate term "pyorrhea"—a term associated with all the varying stages of this condition in the minds of most members of our profession and probably one that has come to be an appellation rather than a term attempting to describe a condition.

From time immemorial we have had with us this mysterious bugbear "pyorrhea," and the control or treatment has largely taken the way of "watchful waiting," or that of attacking the condition without knowledge of the causes producing the breaking down of the investing tissues of the teeth.

I speak of pyorrhea as a condition, and it cannot be spoken of otherwise, for, as J. Kendall Burgess[1] of New York says, "pyorrhea is not a disease unless one should consider a mashed thumb and its sequelae a disease. It is a condition due to injury of the tissues, not necessarily through accidental violence, but rather an incidental injury or trauma due to abnormal physical contact and relations—a traumatic disturbance in which nature sets about to care for the injury just as she would one of a similar Nature in any part of the body."

The controversy raging around the question as to whether or not this condition is one of local or constitutional concern is probably productive of more confusion than results in the true understanding of the condition. True, the constitutional aspect must be recognized, but it cannot be given more attention than would be given any local condition the treatment of which would be interfered with by general lack of tone, vitality or constitutional debility of the patient. Faulty metabolism, systemic conditions and predispositions have been indicated as being productive of pyorrhea. Why should these manifest themselves solely around the teeth? Again, why is it that the removal of teeth is a very sure means of eradicating the diseased condition and terminating the pathologic process, and that without systemic treatment in any form?

Let us briefly consider the etiology of periodontal lesions. The structures involved, which we shall know as the investing tissues of the teeth, are the periodontal membrane, with its fibers, osteoblasts and cementoblasts; the alveolar

process and the cementum covering the root of the tooth, and the gums and gingivae. These are specialized elements together making up a perfect unity. If one element fails, the whole structure suffers.

All organs and tissues have a definite function; so they are provided with means of protection in order that their function may not be impaired.

The gingivae surrounding the teeth have a definite function, which is the protection of the underlying tissues and their specialized elements. The gingivae in turn need protection, and this is afforded largely by the form of the teeth.

Let us first consider the possible sources of interference with the protection afforded by the gingivae other than by accident or caries. Most prominent are food debris, deposits of salivary and serumal calculus, injuries resulting from the use of toothpicks, rubber bands and dental floss. Less apparent, perhaps, are those injuries resulting from interproximal wear and attrition. Most of these injuries may produce the primary gingivitis which is invariably a forerunner of later destruction.

Formerly, it was generally believed that most cases of destructive diseases of the investing tissues of the teeth were caused by deposits. This was much greater in former years than now, the gradual reduction being due to the better care of the mouth by our people. A critical examination of the mouths of a large number of adults will establish the fact that the majority of cases at the present time result from slight traumatisms and irritations of the gingivae, and that deposits of calculus are the first cause of a minority. Most cases are later complicated by deposits, and these have often been mistaken for the exciting cause. It frequently requires a very careful study of cases, especially those which have made considerable progress, to determine the beginning or first cause.

Most dentists seem not to have recognized these exciting causes of inflammations of the gingivae at all or, if they have recognized them, they have failed to appreciate the direct relationship between the apparently trivial gingivitis and the more serious lesion of the periodontal membrane which results. In view of our belief that suppurative detachments of the membrane are permanent detachments, if we should fail to treat these areas of gingivitis with close attention and concern, we would ignore a situation the grave danger of which we are well aware.

There are so many conditions that may cause slight inflammations of the gingivae that it is almost impossible to enumerate them all. I shall mention those particularly with which every operator must be familiar and those which are particularly concerned from an operative point of view. Faulty contact points probably cause more destruction in the bicuspid and molar region than anything else. Gingivitis due to this condition may be caused by lack of contact, improper contact or by deviations from the normal smooth contour of the teeth.

Other sources of gingivitis are those that are the result of abuse of the tissues by operators during their operations, and of uncleanliness, the misuse of toothpicks, rubber bands, floss silk, toothbrushes and other accidental injuries. Gingivitis due to lack of contact may result from separations following the extraction of one or more teeth, from abnormalities of occlusion, uneven occlusal wear, and from decays beginning on proximal surfaces which progress unnoticed or uncared for until the enamel forming the contact is completely destroyed. It may result from fillings or crowns which have been placed but which do not make contact. Teeth may have abnormally broad contacts, the normal convexity of proximal surfaces being absent.

Malpositions of teeth in the line of arch are another productive source of gingivitis due to faulty contact. As the result of the slight buccolingual motion

of teeth in mastication, the enamel forming the contact points gradually wears, it being estimated that at the age of 40 sufficient space is lost to equal the mesiodistal breadth of one molar tooth.

Gingivitis may be caused by the injury due to improperly finished fillings and crowns and by ill-fitting dentures, and by the abuse given by dentists, such as the improper use of ligatures, the failures to use carefully the rubberdam, and the indiscriminate use and misuse of finishing instruments, strips and disks. Gingivitis may also be caused by the injuries inflicted during the preparation of roots for crowns and the packing of cavities with guttapercha, without due regard being paid to the protection of the septal tissue.

In no way are the foregoing items more the concern of the operator than are those that affect the patient's own care of his mouth. Every dentist should consider it his duty to inform and warn his patients of the necessity for systematic care of the mouth and also the grave danger lurking in the undue and careless use of picks, dental floss and other "aids" which they may employ. These remarks are in no sense of the word intended as an arraignment, but merely to fix in our minds that a due consideration of these presented facts will enable us to answer for ourselves the questions, Can pyorrhea be prevented? or, Can pyorrhea be controlled?

Perhaps the greatest fault common to most of us is that we do not make mouth examinations. The tendency is to fill cavities, bridge spaces and make dentures. We fail to look at the mouth as a complete organ. Examinations should be made, invariably, so that a record is obtained of each surface of every tooth and the condition of the gingivae recognized and recorded. Contacts should be tested, and every possible source of gingivitis traced as far as possible to its origin.

If we carry out such a plan surely we can try to place fillings, crowns and bridges which do not irritate by their faulty margins and which do not interfere with the normal occlusion, but which restore contact, occlusion and natural tooth form.

In the care of our pyorrhea cases, if we use our judgment in determining our plan of action following a true record of conditions, we shall be forced to the conclusion that the mere treatment of the "pyorrhea" is inadequate unless we, by operative skill, develop such conditions which will best tend to protect and keep the soft tissues free from irritation or trauma, once the present infection has been eliminated.

Dr. Bunting[2], in a paper entitled "Preventive Dentistry," writes as follows: "Could we keep the pulps of all teeth alive and could we keep the periodontal tissues in health, we would strike a blow at the root of the difficulty and would prevent the inception of these periodontal infections which we have learned to fear. By such measures we would obtain an unquestionable guarantee of the safety of dental procedures and would establish an irrefutable alibi for the mouth as a menace to general health."

No one could fail to accept this statement. Our own experiences teach us that prevention is indeed the only real cure.

I venture to state my belief that in the field of operative dentistry alone will be found the true solution of the prevention or control of lesions affecting the soft tissue attachment of the teeth. All treatments that consider pyorrhea as a disease that can be cured or eradicated by medication or by the scaling, planing and polishing of teeth and root surfaces are fundamentally wrong, for they totally disregard conditions only to be remedied by operative procedures, and conditions which a knowledge of the histology and pathology of the tissues involved prove to us are scientifically impossible.

The idea prevalent among the laity and some members of the profession that "prophylaxis" indicates a thorough cleaning of the teeth is to be deplored.

The true idea and meaning of the term prophylaxis is just as much conveyed, and more truly so, in the interpretation which lays it upon us to at least try our best to preserve or restore contact, regain lost septal space, correct occlusion and finish all fillings, crowns and appliances so that Nature is assisted and followed rather than left in the lurch to stagger under the load imposed by our indifference to the true principles of operative dentistry.

## Bibliography

1. Burgess: *Cosmos* 59: 1208, 1917.
2. Bunting: *Dental Digest* 25: 764, 1919.

## Discussion

*J. H. Phillips, Nashville, Tennessee:* The importance of preserving the health of the investing tissues of the teeth cannot be overemphasized. It should be the aim of every dentist, regardless of the specialized field of his endeavor, to do everything possible to protect these tissues from injury during his operations and to guard against subsequent impairment of their integrity through careless or defective work. We cannot "let George do it." Recognizing a joint responsibility, all must work together. In his paper, Dr. Merrifield has put it up squarely to operative dentistry, and I am in perfect agreement with him.

I stood by a chair recently observing one of our most prominent periodontists at work. His biggest job in this particular case was the removal of gingival overhang of fillings and trimming down gold inlays flush with the gingival margins of the cavities. Those fillings and inlays, mind you, were beauties so far as appearances went, but the exploring tine disclosed most serious defects. In treating dental caries for this patient, the operative man thought, no doubt, that he was complying with every requirement. The disease had been checked, pulps protected and lost tooth structure restored in fairly good form; yet permanent irritants were left under the septal tissue here and there with the results so familiar to all of us—irritation, lowered vitality, infection and tissue destruction.

Dr. Merrifield has well said that the form of the tooth itself is a protection to its investing tissues, or to the gingivae, at least, the gingivae in turn protecting the underlying structures. Of course, he had in mind also the relation of the teeth to each other as they stand in the arches, and the form of embrasures. In the surgical treatment of dental caries, these conditions are too often ignored, the investing tissues being left exposed to influences which ultimately cause their undoing. Many cases of pyorrhea can be traced up stream, as it were, to just such a beginning, and their treatment is indeed a constant vigilance, usually unsatisfactory to both patient and dentist.

It is most fortunate that the soft tissues of the mouth are so abundantly supplied with the means of repair. They are, indeed, patient and long suffering. If this were not so, they would have a hopeless fight against the burdens placed on them by the careless operator.

I do not know of a calling in which absolute honesty counts for more than it does in dentistry. The dentist who is genuinely in earnest in rendering service looks beyond the tooth to the general physical well-being of his patient. He leaves nothing to chance. Every operation represents his best efforts and he is never too lazy or too busy to put into his work all that may be demanded of his knowledge and skill. In the field of operative dentistry, let us really know tooth form and respect its significance.

*F. R. Henshaw, Indianapolis, Indiana:* I think that all of us are particularly interested in offering to our patients those things that will do the greatest good, and therefore, the bringing out of the necessary relationship between the operations of the one class and the other is particularly interesting and satisfying. Certainly, the periodontists cannot properly function without proper attention to the service of the operative dentist. Dr. Merrifield has put that so beautifully and so well that I merely wish to express my appreciation of the way in which he has brought it to our attention. Certainly, the fundamental basis, after all, of the efforts in prophylaxis reverts back to the original scheme of Nature giving to mankind a normal occlusion, and any and every deviation from this normal occlusion renders the effectiveness of the masticatory apparatus just that much less. Therefore, if we can take home with us the idea that we cannot go alone, that the periodontist and the operative dentist must go hand in hand, that their efforts must be applied in exactly the same direction, and that they must work together and feel together for the benefit and advantage of the patient, we shall arrive at the reasonable and common-sense position that the dentists have been striving to attain.

*Arthur H. Merritt, New York City:* As a periodontist, I want at this time to confess my dependence on operative dentistry. No periodontist can do his work, except through the cooperation of other departments in dentistry. They are so closely interrelated that each is dependent on the other, and each of us in our special field must do our work in

the spirit of cooperation if we ever hope to eliminate troubles in the periodontium. I agree with Dr. Merrifield regarding the broader applications which should be given to the word "prophylaxis." We have used that term too narrowly. It involves the seeing of our problem as a whole. It is not just the cleansing of teeth, as we are so apt to think. It means proper restoration of contact points; it means, also, proper restorations in all forms of oral prosthesis. It means, in a word, seeing our problem in its entirety, and addressing ourselves to the solution of that problem from every point of view.

There is only one thing I would like to say, which may seem to be in disagreement with what Dr. Merrifield has said. In commenting on his slides, he spoke of the operation which he performs and which I have seen him perform; he spoke of some of the tissues which are involved as a result of this disease as being "dead" tissues, and said, in effect, that suppurative detachments of the pericementum are permanent detachments, and that we cannot expect obliteration of pockets. As long ago as 1840, John M. Riggs, of Hartford, claimed that he was able to cure these diseases. The definition of "cure" may mean different things to different people, but if you will look up the definition, you will find that it means simply a restoration to health, not a restoration to conditions which prevailed prior to the initiation of disease, but a return to normality, to health, and it was in this sense, I think, that Riggs used that word. Since that time, for three-quarters of a century, there have been men here and there who have been reiterating the statement made by Riggs. Over thirty years ago, Younger, in a paper which he read before the Second District Dental Society in Brooklyn, made the statement that he not only cured these lesions but that he actually obtained a reattachment of the overlying soft tissues to the cementum. Since that time, two groups of men working independently and with no knowledge of the work done by the other have recently been able to prove histologically that this was a fact, and while the clinician has had no doubt of it for at least a quarter of a century, there have been other men equally interested, and equally sincere in their belief, who have asserted that the clinician was mistaken, that this was merely an approximation of the soft tissues to the teeth without actual reattachment. These investigators have been able to obtain from patients' teeth that have been treated, and have subjected them to careful histologic study, only to prove beyond controversy, even to the most skeptical, that an actual and literal reattachment takes place, by which the overlying soft tissues are actually reattached to the cementum, proving by that fact alone that the cementum in the vital tooth is not a dead tissue. I think you are all agreed that if it is possible to obliterate these pockets in this way, it is preferable to any operative procedure that we may institute for the removal of the overlying soft tissue, as has been indicated by Dr. Merrifield.

*Dr. Merrifield (closing):* When Dr. Merrit mentioned the fact that I talked of dead tissues, of course it was not my intention to have you infer that those tissues were just as dead as though life had passed out of the body. As a matter of fact, they are not dead, according to our physiologists, but they are dead from the standpoint of comparison between the tissue in its normal condition, when it is fully and normally attached to the teeth, and the condition which it is in because of the infection which has invaded those areas and destroyed the attachment to the periodontal membrane.

In regard to the question whether or not suppurated detachments of the periodontal membrane are permanent or not, Dr. Fred Noyes, who has probably done more research work in the histologic field on the subject than any other man, and whom, I think, I may quote as an authority, said, in conferring with me, that as far as he had been able to find out we could take it that these suppurated conditions had to be considered as permanent detachments, but he said he would not want to go on record as having said that, nor would I like to make it as a positive statement. As a matter of fact, I think we all agree, in view of the happenings that have occurred within the last five years, that it is a very brave man who will make a positive statement and say that this cannot be done and that cannot be done, because every day we get new instances of things that yesterday would have appeared impossible, and yet today they are taken as a matter of course. There is a possibility that under favorable conditions there might be reattachment as Dr. Merritt has outlined. No one will dispute the fact that if tissues can be reattached, this treatment would be much preferable to excision. But by and large, and considering the greatest good to the greatest number, the operative procedure or the method of attack which will produce in the mouth an elimination of infection in the shortest time and which will render the mouth resistant to further infection is a proper method of procedure. I am not disputing the fact that Dr. Merritt can produce evidence to show that these tissues can be reattached, but I doubt whether in the greatest number of cases or in the majority of cases these attachments or reattachments can be produced.

# REMOVABLE BRIDGEWORK

By B. B. McCOLLUM, D.D.S., Los Angeles, California

(Read before the American Dental Association, Cleveland, Ohio, September 10-14, 1923)

DENTISTRY has surely inherited or acquired her full share of unfortunate nomenclature, though probably not to any greater extent than the other professions. Not the least of these unfortunate terms is "bridgework." The word *bridge* may express some of the more apparent mechanical features of the operation, but in so doing it conveys a wrong impression of the importance and purposes of what is being done, both to the patient and to the operator. Perhaps it is unfortunate that we are compelled, for the sake of convenience, to name so definitely and to separate and classify so distinctly the various parts of a dental operation. Maybe, if we did not have to do that, the dentist would not be *selling* inlays, crowns and bridges and the patient *buying* them at so much a piece, instead of treating the various mechanical devices we use for restorations as *remedies* to be studied and applied as their various qualifications dictate.

For the consummation of our conclusions following a diagnosis, mechanical ability is absolutely essential. Dentistry is a constructive surgical operation, and the ability to fabricate our remedies demands mechanical dexterity. But without surgical sense, all the mechanical dexterity in the world could never have made a dentist. Dentistry is surgical in all its aspects. Dentistry uses mechanical principles and mechanical devices only as a means to achieve a purpose.

Arbitrary rules and regulations, therefore, must be the beginning of every operation, but the final result should conform to anatomic and physiologic requirements. Every surgeon starts an operation from definite arbitrary landmarks, but he soon finds himself deviating and conforming to the surgical necessities of the conditions to be dealt with. The general surgeon's operation differs from ours only in that his work is destructive, while our work requires constructive ability to the extent of restoring in whole or in part the health and function of what is no doubt rightly considered by many the most important part of the body.

As a matter of fact, we are undertaking to make Nature tolerate a foreign body. We succeed in our efforts only because Nature created the tissues on which we operate, adaptable to the purpose we have in mind. Probably nowhere else in Nature do we find greater adaptability than in the tissues of the mouth. Even the soft tissues after the teeth are removed adapt themselves to the stress of mastication to a most remarkable extent. But the way the teeth themselves accept and retain restorations of merit and stand up under abuse is little short of miraculous.

We have allowed the phrase, "mechanical dentistry" to creep into our language. Would it not be better to say the "mechanics of dentistry," thereby at once separating the means by which we achieve our aim from the purpose we have in hand.

As dentists, our purpose is not to make an inlay, a crown or a bridge, but to create by mechanical means a remedy for a dental lesion. But to hear the way we ourselves and the laity speak of our efforts one would think we were dealing in merchandise. Branding our efforts with a name has placed them on the shelf with common articles of commerce to be taken down, shown to the shopper, and a price set on them to be bought and sold like commodities. I cannot believe that the misfortune of an unwisely placed name could do more harm than in our profession. The products of our brains and hands are not commodities. Our efforts produce nothing of intrinsic value. But if our diagnosis is well made, our prescription properly thought out and the directions duly executed, the result is a created condition the value of which cannot be measured in money.

The dentist or physician has nothing to sell. He stands or should stand before the public as a person especially prepared and equipped to give advice, administer treatment or perform operations for the prevention of disease, or help Nature repair or compensate for the ravages of disease.

I wish that we might find names for our remedies which would not at once associate our efforts with something the patient can buy. The fee paid by the patient is not the market value of any article of commerce. The fee of the dentist or physician bears no relation to the value of the service rendered. The fee is simply the price in money that the public is obliged to contribute to induce and enable dentists and physicians to equip and maintain themselves in readiness to render the needed service.

The results of our efforts are just as arbitrarily our own as is the thinking and advice of the attorney. The client or patient may go elsewhere and get other and better advice or treatment; but there is no other place on earth where the same combination of intellect and results are obtainable. That one thought in itself, coupled with the knowledge of our very real indispensability to the welfare of the human race, is dignity enough for any one professional man without the addition of another "dentist" or high-sounding phrase to a list which was already too long before it reached the second word.

We seem to be impressed even by such nonsensical phrases as "dental engineer." Look in your dictionary. An engineer is one who contrives and executes, or superintends the execution of a plan. A plain, simple dentist is all that without the undignified addition of a single phrase or word of buncombe.

No greater service could be done for our profession than to clear our language of misleading terms. Shakespeare's idea of the name and the rose may be all right, but the public is not educated to an understanding of our science and art, and naturally associates common names with things and circumstances with which they are familiar. If you want an exasperating example of the effect of unfortunate terms, just use the word *bite* to your patient when you want the position of the mandible in central occlusion.

Perhaps I have wasted some of your valuable time in a discussion of what seems a trivial matter of words. But words are the means by which our thoughts are conveyed (or concealed, as

somebody said). The elimination of some of our more unfortunate terms would do much to correct the misconception the public often has of our efforts. We spend time debating whether it is radiogram or radiograph, and then leave unnoticed words and terms that really do us untold harm. I care not how homely a phrase may be, just so that it does not create misconception.

We owe it to the public to create in them a high regard for our profession, to which the importance of our being entitles us. All our words, actions and attitudes should be carefully selected with that in mind. The exhibition of samples, that is, the parading of technic models before the patient in an effort to sell him something, to my mind does not contribute anything to the respect the public should have for us. What would you think of a physician who displayed his remedies and extolled their virtues before his patient and offered the patient a choice in their selection—at a price?

If every dentist had only one standard of operation and operated as a surgeon should, placing every mouth coming under his care in proper condition, according to the best knowledge of the day, in a remarkably short time our status with the public would be changed. By one standard of operation I do not mean that all dentists should think and work alike, or even in a similar way. But it is the bounden duty of every dentist to satisfy himself that to the limits of his opportunity the remedy that he recommends for any given lesion is the best,—yes, the very best—of which it is his privilege to have knowledge, and to administer that remedy or none at all.

It is certainly the patient's privilege to choose his dentist, but when the patient's judgment enters into the choice of his dentistry, both "parties" to the affair are "out of luck." The dentist has lost his rightful place of esteem and the poor patient is in the hands of a bad dentist.

The story of the metabolic value of a tooth has not yet been told. The loss of one tooth or even part of a tooth may interfere seriously with the function of the masticatory apparatus. To what extent this interference plays havoc with general metabolism is yet to be discovered. But we do know that to destroy the function of the masticatory apparatus produces a slow, insiduous undermining of the general health, the full effect of which may come years after the damage was done.

It is all right to extract teeth that are a menace as a foci of infection, or for any other good reason; but to "clean up a mouth," as is frequently advocated by some of our most prominent physicians and surgeons and even dentists, and leave the patient a dental cripple is to lay the foundation for future ill health that will not be cured by extracting more teeth. Man was intended to have a good, clean, efficient masticatory apparatus. Any time that a tooth or part of a tooth is lost which interferes with the proper functioning of this important organ and no acceptable substitute is provided to compensate for this loss, a price is going to be exacted by Mother Nature. The metabolic value of one tooth may be said to be the value of the whole mouth, for the metabolic value of the mouth as an organ of mastication is apparent only when a full complement of teeth (or acceptable substitutes) are working in harmony. The loss of one tooth can destroy that harmony.

That famous saying, "The next great step in preventive medicine must come from the dentist," is not going to be answered by the mere extraction of teeth and ridding the mouth of infection. The

patient may come in on a stretcher and walk out an apparently well man after such treatment, but unless the dentist comes to his rescue with an operation to substitute the missing teeth, his relief is only temporary. The next great step in preventive medicine is the realization by dentists, surgeons and physicians of the metabolic value of the masticatory apparatus and of the fact that each tooth plays an important and essential part in that apparatus. All good dentistry is preventive medicine of the highest degree.

There are so many threads of fine-spun theories running through the warp and woof of the fabric of our dental literature that it is no small wonder that so much confusion dominates any effort on one's part to construct for oneself a garment of fact and truth.

Many of these theories remind us of the plight of the king's wise men who debated for years the proposition as to whether a live fish placed in a vessel of water added to the weight, the theory being that the buoyancy of the fish counteracted the pull of gravity, etc. The argument filled volumes. The king's jester settled the question beyond doubt by bringing in the scales and putting the matter to the test.

Most of our problems must be weighed in the balances of clinical experiences. Many fine-spun theories are found wanting. The tooth that will not tolerate interference of such and such a type because of so and so will very often be found in clinical experience doing the very thing the wise men said it would not do. You all know the story of the man who was in jail, despite the consolation of his lawyer who said he could not be imprisoned for such an offense.

In no other branch of dentistry have we had, or do we now have, more hair-splitting theories than in partial restorations of all kinds. Replacing totally lost parts of the dental apparatus seems to offer a field for theorizing that knows no bounds. The whole atmosphere of the situation is son confused and surcharged with contradictions that it almost gives one a headache to think on the subject. Volumes have been written. The numerous contradictions show that somebody must be wrong. Too much of the material is not based on any element of fact but is couched in language calculated to take advantage of the cupidity of a much misled profession.

The future of dentistry is dependent on the willingness and ability of each individual operator to think for himself. Before any idea is accepted and practiced, it should be thought out carefully and made completely one's own. Because we did not originate an idea does not prevent us from owning it. The world has and needs few original thinkers. Originality for the rank and file of us is not necessary. We can make the best thought of the world our very own and can improve on it without compunction, because we have not the prejudices of the fond parent for his child.

The men with the test tubes and the microscopes serve an invaluable purpose, but after all it is the observation, reflection and recording done by the active operators as the result of actual clinical experience that will make dentistry good and great. Dentistry is no better than the rank and file of us.

A knowledge of the conditions with which we are to deal is absolutely essential up to the very limit of every means at our command. Dental diseases are not clean-cut, sharply defined, medical entities like pneumonia, typhoid, etc. Practically every disease with which we deal has a subtle, insiduous inception and its course covers a period of perhaps years and years. The symptoms and treatment may vary at different stages of the disease as widely as though the disease itself were different. But none the less, dental diseases are medical entities. We must learn to treat them as such. The United States Army and Navy sees its boys through pneumonia,

typhoid, etc., but the dental lesions are patched up from time to time to relieve pain without a thought of the necessity for a complete and efficient organ of mastication. Most people live in spite of the condition of their mouths, instead of having a clean, wholesome condition of the oral cavity that is the best life insurance in the world.

Every man, woman and child in the world is entitled to the services of a profession that fully realizes the importance of its undertaking. The right attitude on our part insures the public of proper attention. Then the so-called education of the public, which is nine-tenths commercial propaganda, will be no longer considered.

When arrested and cured at any stage, a dental lesion may have left a permanent mark. Bone that is rarefied or condensed may never (probably never does) return entirely to normal. Where the gingivae have been attacked there will be left a condition that cannot be entirely eradicated. Trauma of all kinds leaves its imprint to remain indefinitely.

Nothing but the radiogram gives us a record of bone and root conditions, and nothing else gives us so good a record of tissue relationship as regards the tooth roots to each other and to the bone and soft tissues.

The most important records we make are the ones after the operation is finished. At this time a good record of the case will fortify us against a wrong diagnosis in the future. For instance, two years after an operation, everything may not be ideal, but if we have access to records made before and immediately after the operation, we may find that what we see is an improvement over original conditions.

It is a great mistake to condemn an operation as wholly unsuccessful without access to proper data from which to draw conclusions. Suppose that a man was mangled in an accident and his face was mutilated beyond recognition; the results obtained by the surgeon might be anything but satisfactory, but a knowledge of the conditions dealt with might make a very undesirable result seem little short of miraculous. Improperly contrived and executed dental remedies carry their own evidence for condemnation and are not to be condoned for one minute.

When the operation is finished, the radiographic records must show no overhanging, tissue-irritating restorations. The contact point and the relation of the proximal surfaces should be so arranged that the investing tissues are almost guaranteed protection and long life. The relationship of neighboring teeth is shown by the radiogram as nothing else will show it.

In a few short words, the records of our finished operation should show that the operation was a success even though the result obtained proved unsatisfactory. The failure, if it must come, must be in spite of, and not because of, the operation. In some unaccountable way, the public expects a dental operation to last a lifetime. The public's attitude must be the result of what we have taught them or allowed them to believe.

The pleasure of the patient is generally taken as the measure of success. A pleased patient is a most valuable asset, but we all know that he is no indication of a successful operation.

To Herman E. S. Chayes belongs a world of credit for the development of removable restoration technic. The influence of his teaching has permeated even the realms of fixed restorations. We see men advocating fixed appliances in two or more pieces to allow for "individual tooth movements." Most, if not all, of the attachments requiring accuracy of technic have directly resulted from his efforts to produce something worth while. But unfortunately, the overdrawn theories he advocated have taken hold more firmly than the rich store of accurate technic which he gave us.

The postulate "teeth move in function" has undoubtedly colored to no small degree much of the recent thought along the line of all partial restorations, both fixed and removable. Teeth do not move in function in the sense that your finger on your arm moves; yet the effect of immobilizing the arm is given as an example of the result of so-called fixation of the teeth. Teeth do not move in function, but to say that they are moved may be a different story.

Clinical observation coupled with histologic investigation would rather indicate the movement almost nil. The structure of the alveolar process indicates that Nature strives for rigidity. Observe the interlacing braces of bone of which it is composed. If it is true that the periodontal membrane contains no elastic tissue, then the arrangements of the fibers of which the membrane is composed fulfills every requirement that a mechanical engineer would ask for if he desired rigidity.

Added stress which does not pass beyond the point of toleration stimulates rigidity in a tooth. We find teeth serving as retainers for partial plates or under heavy occlusion becoming rigidly ankylosed. You have all extracted such teeth. So-called fixation is given as the dominant factor in the exfoliation of abutment teeth in fixed appliances—this in spite of the fact that the exfoliated teeth are buried under the most absurd gold shell crown or ill-fitting inlays imaginable, and all so out of occlusion that the wonder is that they stood the strain for even a day. How can so-called fixation be singled out as the dominant factor in such cases?

Anyway, one moving object could hardly be fixed or deprived of motion by attaching it to another moving object. No clinical evidence has yet been produced to show that any two teeth tied together will not adapt themselves to the new condition, provided the load they are asked to carry does not go entirely beyond their endurance. It is not asking too much of any two teeth that they allow themselves to be moved in the same direction at the same time, provided the amount of movement induced is not beyond the original limit provided by Nature. There is no doubt a limit to the amount of stress teeth will stand, but it is very doubtful whether we will ever be able to determine the capacity of any individual tooth, any more than we can predict the number of years any man will live. But clinical evidence may teach us something of the chance we are allowed to take, just as the mortuary tables enable the insurance companies to bet with us about our lives.

Faulty occlusion plays a most prominent part in the exfoliation of either individual or abutment teeth. Stress brought to bear in a direction and of a magnitude for which the tooth is by nature wholly unprepared to meet is the hardest element to control in either fixed or removable appliances. If we could construct and antagonize our restorations so that the teeth would not be moved in function, the intention of Nature would be more nearly fulfilled.

When we ask a tooth to act as a retaining agent for a removable appliance, we must see that no undue stress is allowed to break the moorings of that tooth. In appliances of the cantilever type, stress must be broken. But, on the other hand, the movement of the restoration must be controlled. The stress breaker should be so constructed that the amount of movement may be so adjusted as just to compensate for the resiliency of the tissue. By such an adjustment the movement of the appliance will be considerable in soft tissue and very little where the tissue is firm, but in any case there must be accommodation sufficient to prevent the movement of the teeth which act as retainers.

All stress-breaking adjustments must be independent of the attachments so that the appliance is held properly in position. Every part of the appliance should be constructed tight and close

fitting. The adjustments for movement should be made after the operation is completed and, as said before, the amount of the accommodating movement made just sufficient and no more than is necessary. Stress-breaking appliances which have no adjustment of the amount of movement must naturally have enough movement to accommodate the extreme cases, resulting in entirely too much movement in the majority of cases.

The adaptation of the saddle to the tissue is important. Many ways have been tried, but the impression made in specially constructed vulcanite trays, using impression compound under biting stress with the resulting impression poured in some sort of artificial stone, seems to offer the best results. The tray should fit the case. The tray being made of vulcanite, the compound is kept soft much longer, thus allowing it to flow and adapt itself to the tissue or rather allowing the tissues to take their normal position under the natural stress of occlusion. The compound should be so placed in the tray that it will be made to flow up over the side of the ridge toward the crest.

In small cases, the saddle should be just of sufficient size to make the case comfortable. The lost tissue should be as nearly as possible compensated for. Large extensive saddles in any case except the cantilever type are uncomfortable and unnecessary. When the case is wholly tissue bearing, it goes without saying that the more tissue that can be put to work the better. Some fanciful ideas have been developed regarding the relative amount of stress the soft tissues can be made to assume when there are attachments in supporting teeth at each end of a removable restoration. Some of the stress may or may not be transmitted to the soft tissues; no way has been devised to measure the conditions presented, but, in any event, a closely adapted saddle that does not bear down on any place or places to the point of strangling the tissue is a comfort-giving device.

We cannot hope to imitate Nature, but we can study the physical laws by which she accomplishes her purpose and can take advantage of her ways to create an acceptable substitute for missing parts of the masticatory apparatus. There is small doubt about the mouth, as an organ of mastication, being governed by physical laws. The teeth in a normal condition bear a mechanical relation to each other that prolongs their life and usefulness and enables them to function to the greatest capacity. Any interference with this mechanical relationship at once upsets the balance and induces a pathologic condition to a degree corresponding to the amount of interference.

The physical laws of dentistry should and will give us great concern in the future. It is the open-sesame to everything we undertake. The orthodontist must know a lot about it, in fact, all that can be known. The periodontist's work can be nullified by any lack of proper mechanical relationship between the teeth. Even the exodontist should understand the physical laws of mastication, or he will do untold harm by the unnecessary removal of tissue that can never be replaced.

The relation of each tooth to its neighbor is of prime importance to the welfare of the investing tissues. Tooth form in our restorations cannot be too emphatically demanded. The laws governing tooth form are relentless, severe and unforgiving, as shown by the slow but sure destruction where normal tooth form is absent, either by some freak of nature, or lack of proper application by the dentist, of the principles governing it.

But more important still is the relation of the teeth of the opposing arches. Much has been done in the last few years to bring to light the physical laws governing the proper relation of the maxillary and mandibular teeth.

The movements of the mandible have engrossed the minds of many of our

best thinkers. Bonwill, Snow, Wilson, Kerr, Gysi, Hall, Monson, Needles, Wadsworth and many others have each contributed something to our understanding. But nearly all of the investigations have been in regard to full denture construction. Some have concentrated on the condyle path as the index to be sought; others on the cusp planes, and still others have tried to reduce the problem to a mere matter of plain mathematics.

Not enough work has been done to find out what constitutes normal occlusion. Edentulous cases that have acquired bad habits in an attempt to adapt themselves, or mutilated mouths that no longer represent the original intention of Nature make bad subjects. Like most of our studies of tooth form, our opinions are in danger of being formed from bad material. Nearly all, if not all, of the studies of tooth form in our dental anatomy textbooks are made from extracted teeth. Almost without exception there is good reason to believe that there is something the matter with the form of these teeth which caused them to be extracted. At least such a condition is to be suspected.

In nearly every case requiring the complete restoration of one or more teeth, and even in cases where no teeth are missing, there is apt to be marked derangement of occlusion. Under such circumstances there should and must be developed a way of determining what Nature intended the original condition to be. We cannot do it by saying that all mouths should be alike and proceed at once to cut and fit to mathematical measurements. God's work can never be measured with a yardstick. Yet under normal conditions we find Nature working by means of, and in strict harmony with, physical laws. In fact, Nature's deviations from the normal are in strict accord with physical laws. Deviations, while not normal, are none the less natural. There is a wide distinction between normal and natural, and the two should never be confused. The wear on the proximal surface of the teeth is the natural course of events, but it is not normal because it breaks up the mechanical relationship that should exist between the teeth, and trouble results.

I have no pet theory of articulation and occlusion to promulgate, nor is this paper intended to be an exposition of any panacea for our troubles. But so important is the proper relation of the maxillary and mandibular teeth to each other that I feel justified in saying that the future of dentistry in all its branches depends on the solution and understanding by the rank and file of us of this serious problem.

In the first place, we have no definite understanding of the words *articulation* and *occlusion*. Neither of these two words alone or both together convey the idea we might wish to express. I feel compelled now to define them. *Occlusion* means to me to be the teeth of the opposite arches touching and at rest in any of the various positions which the mandible may assume. Occlusion must, therefore, be further modified as central, right and left lateral, protrusive, retrusive, functional, etc. *Functional occlusion* is the passage of the teeth in contact from one occlusal position to another. Functional occlusion is really our problem. *Articulation* is defined by the American Dental Association[1] as the arrangement of artificial teeth to conform to the requirements of edentulous space or spaces which they are to occupy.

That the normal functional occlusion of human teeth is the numerous segments of the surfaces of two concentric spheres passing over each other, there seems to be little doubt. All of the various articulators, except Hall's, have been most beautifully and graphically demonstrated to be spherical in principle by that logical and constructive thinker,

1. Report of The Committee on Nomenclature.

Needles, of Pueblo, Colorado. Monson has no doubt been the inspiration for the development of the spherical theory. Hanau has ridiculed Monson, Needles and others about the idea of spherical occlusion. Yet it can be proved, in spite of his dental engineering, that Hanau's articulation, and Gysi's, Needles', Wadsworth's and all others having an incisal guide plane and of similar construction are spherical in principle and practice.

Frank Wadsworth has developed an instrument and a technic that offers a wide range of possibilities for the reconstruction of mutilated mouths, where normal functional occlusion has been lost or never existed.

Every surgical operation must be preceded by a diagnosis. The actual operation begins in a purely arbitrary manner from known landmarks. But the conclusion should be anything but arbitrary.

Wadsworth's instruments enable us to make a diagnosis and establish landmarks on which we may base our plan of procedure, at the same time allowing us to compromise at any stage to meet the surgical necessities of the case.

I believe that it will be proved soon that not only are the two arches related to each other as numerous segments of the surfaces of two concentric spheres, but that the circumferences of these spheres pass directly through the mandibular joint, thus making the occlusion of the masticatory apparatus conform to the principles of a good machine. At least this arc of circumference must pass close enough to the mandibular joint to come within the limits of the flexibility of this joint or we will have lack of balance and so-called traumatic occlusion. When this one point reaches the attention of the orthodontists, most of their troubles of retention will be solved, and the dentist who is attempting to reconstruct mutilated mouths will receive much help and information from their clinical experiences, because their experiences will be based on the behavior of full natural dentures.

Every dentist should read Harvey Stallard's[2] article, "The Anterior Component of the Force of Mastication." This article sheds much light on this important principle.

With Wadsworth's instrument and face bone technic, it is possible to locate the study models on the instrument very nearly, if not exactly, in the same relation to the mandibular joint as the teeth occupy in the mouth. Then, by means of the centering disk the case can be measured and studied.

In full denture construction, in all but very exceptional cases, the arc or curve may be made to conform with the foregoing requirements very easily. The results are little short of marvelous.

In too many of the mutilated natural dentures the desired results are not so easy to obtain. Some of the molars and bicuspids will be found so out of harmony with this curve that it is a physical impossibility to make them conform. In such a case, the results obtained will not be all that is to be desired. But if every effort is made, it is possible in practically every case to come within the limits of the flexibility of the mandibular joint, thus making the condition tolerable.

With the Wadsworth technic, the patient is given teeth with cusps and incline planes that balance and interplay in every position of occlusion. So-called three-point contact becomes a numerous series of contacts on every tooth in every occluding position of the mandible, thereby insuring balance and stability to every part of the masticatory apparatus.

It is possible to construct the teeth with pronounced, well-defined cusps so that there is efficiency in mastication, and the mouth becomes a true mill, as Nature intended it to be. At the same time the cusps do not become the so-

2. Stallard, Harvey: The Anterior Component of the Force of Mastication and Its Significance to the Dental Apparatus, *Dental Cosmos* 65: 457 (May) 1923.

called guiding factor in the movements of the mandible, but the whole apparatus becomes one coordinating unit that does not wear itself out by improper antagonism, as the parts of a badly constructed machine are wont to do. Well-balanced full dentures do not cause absorption of tissue with loss of retention, and partial restorations properly articulated do not destroy the retaining and remaining teeth.

The technic employed in the restoration of mutilated natural dentures should attempt to bring the conditions just as nearly back to normal as possible without attempting mathematical conformity to any given theory. No abnormal conditions should be perpetuated that can be removed; at the same time, no attempt should be made to do the impossible. Gysi's measurements made too much concern about the present condition of the patient, with no attempt to build up a better one. Hall paid little, if any, attention at all to any measurements to determine the present condition of the patient, but constructed a set of dentures along arbitrary lines. Diametrically opposed as they are, both men will be found to have contributed generously to our understanding.

The question is often asked, Is it ever justifiable to remove a pulp from a tooth to make the curve correspond to what the measurements indicate? Yes, and no. The operation must not end in an arbitrary mathematical calculation, but if a tooth were so out of line that it menaced the life and function of the masticatory apparatus, I should even go so far as to extract it. I should certainly take the pulp out before I extracted a tooth. No tooth pulp should ever be removed to accommodate any particular form of attachment or filling. There are too many ways of accomplishing our aim without resorting to pulp removal for such a purpose. But we amputate men's arms and legs as a last resort, and I would say that one should remove the pulp or extract a tooth to save the life of the masticatory apparatus. All soft tissue that is in the way should be removed before any sort of a restoration is attempted. The mouth should be prepared in every way to insure the greatest possibility of a successful operation.

A dental operation consists of the application of all the remedies necessary to place the whole masticatory apparatus in order. None of the various remedies which we fabricate should be confused as an operation in itself. Our various remedies are only stages or steps which, all taken together, constitute a constructive surgical operation. The importance of our attitude in this regard cannot be too strongly urged and impressed.

# ALVEOLAR PROCESS RESECTION

By CARL D. LUCAS, D.D.S., Kansas City, Missouri

(Read before the American Dental Association, Cleveland, Ohio, September 10-14, 1923)

SINCE I presented the first article on this subject, many articles have appeared in our dental journals and much discussion has arisen regarding the originator of the surgical procedure, all of which is beneath the dignity of further consideration. Priority is, and should be, a matter of mere incidence. The merit of the operation, however, should be discussed and proved or disproved, the benefit to the patient being the only consideration.

The only logical excuse for any surgical procedure lies in the benefits which may accrue to the patient; therefore, we shall consider the matter from the standpoint of the patient's interests only.

Any surgical procedure which involves manipulation of osseous tissue should not even be contemplated, unless the operator is thoroughly familiar with, and rigidly adheres to, the most strict routine of surgical technic. Extraneous pathogenic micro-organisms must not be permitted to gain access to osseous tissues in bone surgical technics, on account of the susceptibility of this tissue to infection and subsequent destruction by certain of such pathogens.

Since previous articles have dealt at length and in detail with the surgical technics to be observed in the performance of alveolar process resection, I shall not repeat the details of that phase of the work.

The purposes of this operation have also been detailed, to a certain extent, as follows: (1) the preparation of the jaws for the early reception of denture or bridge restorations; (2) making it possible for the replacement of lost teeth upon the resultant ridges, so that the substitutes will set at the proper cervico-incisal angle for the fulfillment of cosmetic requirements; (3) relief of extensive undercuts; (4) elimination of oral foci of periapical infection, and (5) precluding irritation which dentures occasionally produce by resting upon jagged spines of alveolar process.

Full upper and lower impressions of the mouth, before the condemned teeth are removed, should be made, and subsequently the extracted teeth should be placed in their respective impressions in these full upper and lower impressions. Weinstein's plaster should be poured into these impressions and the impressions separated from the models. This will result in an exact gingivodental arch-form duplication of the patient's dental mechanism, which will unquestionably aid the prosthetist in his reconstruction work.

Another set of full upper and lower impressions should be made before surgical intervention, and study models constructed therefrom. These models should be articulated according to occlusion, the plaster teeth cut from the models and the resultant relation of the upper to the lower ridges noted. The prosthetist should indicate by pencil markings on these models the amount of tissue he wishes the extractor to remove as an aid to future alinement of denture teeth or pontics upon the ridges.

In the meantime, the extractor should have completed his physical examination of the patient. The history should include a complete record of objective dental conditions, a radiographic interpretation of pathologic lesions and foci of dental infections, a record of condition of tonsils, sinuses and pharynx, a notation of missing teeth, a record of subjective and objective physical symptoms, vascular tension, pulse, temperature and respiration, the clotting time of the blood, urinalysis, both chemical and microscopic, if the chemical analysis discloses albumin, and finally the patient should be advised of the nature and extent of the contemplated surgical procedure.

The physical examination will indicate the kind of anesthetic to be employed. If the patient is of the extremely nervous type and general anesthesia is not contraindicated, we feel that general anesthesia should be the choice. If a general anesthetic is chosen, the patient should be placed in the hospital at least twelve hours before the scheduled time for operation. The diet during this time should be limited to liquids; a cathartic should be administered eight hours previous to the operative schedule; and a high soapsuds enema given four hours before the operation. A hypodermic of 1/6 to 1/4 grain of morphin sulphate, with 1/200 to 1/150 grains of atropin sulphate should be given forty-five minutes before operation, the dosage to be governed by the age, weight and physical condition of the patient. Nitrous oxid induction and ether sequence is the anesthetic of choice, if the physical condition does not contraindicate ether. If there is evidence of pulmonary or kidney involvement, nitrous oxid-oxygen anesthesia should be administered throughout the operation.

However, definite pulmonary pathologic symptoms or symptoms of nephritis would contraindicate general anesthesia. Conductive anesthesia should be employed in such complications, and, in these cases, the curettement of multiple periapical lesions is contraindicated. Surgical judgment must be exercised in such cases; therefore, set rules of procedure cannot be defined.

My experience has been that discriminating patients appreciate hospital facilities in all cases of extensive mouth surgical procedures; therefore, I venture the prediction that the majority of our cases, in the near future, will request hospitalization, for local as well as general anesthetic surgical procedures.

After anesthetic induction, the patient should be placed in the supine position, and the face sponged with 70 per cent alcohol, then sponged with 2 per cent iodin, and again sponged with 70 per cent alcohol and covered with sterile gauze, leaving only the mouth and lips exposed. The operator must insist on sterile anesthetic.

Tissue retractors may be introduced for retraction of the cheeks and lips, the field of operation desiccated, isolated with breast sponges, the field sponged with 70 per cent alcohol, then with 2 per cent iodin and sponged again with 70 per cent alcohol. Dry sponges should be so arranged as to protect the pharynx from foreign substances, such as fragments of fillings, crown facings and dissociated teeth, thereby precluding aspiration of foreign substances as well as blood and saliva into the pharynx and bronchi. The condemned teeth may then be dissociated with forceps, elevators or chisels.

Having predetermined the extent of resection necessary, as sketched on the study models, the gums should be dissected from the alveolar process to the desired point and the process resection made with rongeur forceps. All pathologic sockets must be carefully curetted, sponged with 95 per cent phenol, and then flooded with 70 per cent alcohol and all of the exposed process sponged with 70 per cent alcohol.

When the teeth which are to be dissociated are excementotic, their extraction with forceps or elevators will occasionally

produce fracture of the alveolus and, in cemento-alveolar ankylosis, a portion of the alveolus will fracture and come away with the tooth, leaving jagged margins. If the roentgenograms disclose these conditions, a lesser loss of process will result if the external or, in specific cases, the lingual plate of process is dissected from the root before the tooth is removed, as advised by B. S. Gardner in his classical surgical procedures in such cases.

When extensive osseous periapical rarefactions are observed roentgenographically in localized areas, more especially in the upper jaw, with the adjacent process uncomplicated by such lesions, a crescent-shaped mucoperiosteal flap, with its convexity presenting gingivally, should be dissected from the process, a window resection made in the process, the tooth or affected teeth removed with forceps and the infected granulation tissue curetted from the socket or sockets through the window, the rarefied area treated with phenol and alcohol, and the mucoperiosteal flap sutured to its original position with two or three interrupted dermal sutures. In this technic the orifice of the socket may be left intact, whenever cosmetic or prosthetic requirements indicate such postoperative results, such as the placement of porcelain tipped pontics.

I realize that definite rules cannot be outlined as routine procedures in alveolar process resections. Each case is an entity, and surgical judgment, a concrete knowledge of practical application in prosthesis and requirements for fulfilling mouth prerequisites for it, a knowledge of the laws of physics, leverages, and atmospheric pressure, and of the adaptation of hard substances to pliable tissues to gain proper valve seating pressure, and a knowledge of surgical and mechanical principles generally are the elements of understanding which enable the operator to gain uniformly good results for his patients.

In some cases, where from two to six approximating teeth are to be removed, I usually find that a very small amount of the outer alveolar plate should be resected and in other cases no resection whatever is indicated. However, extreme orthognathic cases would suggest resection as an expediency in early prosthetic restoration requirements. The labial plate of process should be resected approximately 2 or 3 mm. above its orificial margin, and the interseptal process in proportion. In prognathic conditions, the same general rules would apply for the anterior teeth.

I have always most strenuously advised against resection of the lingual plate of the alveolar process. Many extractors have unquestionably ruined the mouths of patients, from a prosthetic replacement standpoint, by resecting not only the external alveolar process to the apexes of all sockets, but proceeding so radically as to include even the tuberosities, then resecting the lingual plates of process to a point halfway to the apexes of the sockets. I am confident that such erroneous procedures were fostered by a desire to get good adaptation of the outer and inner gum tissues for suturing. Process resection was very hurriedly adopted by many of the profession immediately after the publication of my first article, and the results of some of the operators are most miserable abortions, considered from a surgical as well as a prosthetic standpoint. However, most innovations in surgery result in damage to patients by incompetent operators who elect to proceed, post haste, with their generalized ideas, which may have been gleaned from merely reading a paper published in a journal.

No conscientious operator will foist an operation on the profession until its merits have been thoroughly proved in his clinic. Alveolar process resections were performed in my clinic eight or ten years before my first published article on the subject appeared, and I was absolutely sure of the merits before one word

was written on the subject. My conclusions were drawn by observations and comparisons of recorded cases, from the standpoint of postoperative mouth conditions, prosthetic replacement results and stability of dentures, in all cases.

Unfortunately, diametric deviation from surgical routine and principles of applied physics have resulted in disastrous results; however, no operator would care to assume the responsibility for failures other than his own, any more than the therapeutist would wish to assume responsibility for the maladministration of drugs beyond his personal practice.

In several instances, I have found it necessary to resect a portion of the outer alveolar plate of process from three to six months after all of the patient's teeth have been extracted. In these cases, the prosthetist found, by studying articulated models, that he could not construct dentures scientifically, esthetically nor satisfactorily upon the ridges, on account of extensive undercuts, orthognathism, and jagged and irregular spines of process. In these cases, the line of incision was made at the labiocervical or buccocervical margin of the sockets; the mucoperiosteum was dissected from the outer plates; the predetermined amount of process removed; the scar tissue, which had bridged over the sockets, was partially removed by excision, and the mucoperiosteal flap was sutured to place. Sutures may be removed within four days in these cases and the results are very gratifying. I grant that many cases which present for complete or partial upper and lower extraction should not be resected in any degree. In this connection, I allude to patients who have suffered process resorption, due to extensive pathologic periclasia. In such cases, resorption has resulted as a pathologic sequence, and surgical intervention should consist only in the removal of the teeth and the curettage of the pathologic, hyperplastic granulation tissue from the sockets, and treatment of the sockets with phenol and alcohol.

Inflexible rules for resections, to be generally applied, are out of the question; however I would advise against resection to the apical extremities of the tooth sockets in any case. Such procedures would result in extremely firm, inflexible scar tissue formation at the point of adaptation of the rim of the denture. Visualizing a cross section of such a ridge, we would observe a double incline plane or a triangle with its apex at the extremity of the ridge and the base on a horizontal plane with the apexes of the sockets. With the valve seat of the rim of the denture established on this thin mucoperiosteum of dense scar tissue, which results in resection to the apexes of the sockets, the valve seating which controls atmospheric pressure for denture cohesion is rendered inadequate. Stress of mastication exerted either in the incisor or molar and bicuspid regions of the right or left side will therefore dislodge the denture, because the valve seat of the denture rim is not secure and the double incline plane of the ridge places the fulcrum on the apex of the triangular-shaped ridge with the double incline of the opposite or lateral sides of the arch furnishing inadequate cohesive support.

If the outer plate of process is resected to the apical extremities of the sockets, the muscular frenae become foreshortened in the healing process; therefore, deeper muscle trimming will become necessary as a denture stabilizing requisite, reducing the amount of necessary tissue surface-area for establishing physical cohesion of the denture.

In my first article on this subject, I advised resection of the outer plate of process to the apical third of the sockets. This statement should not have been made in a generalized way. In some cases, resections should be made in that degree, but I have learned by experience that we should not resect in every case in that degree. Perhaps the statement should have been this: In some

instances, the process should be resected to the apical one-half of the sockets; in others, to one-third of the outer alveolus; in other cases, merely a sufficient amount of the orifices of the sockets (perhaps from 1 to 3 mm.) to permit the proper alinement of prosthetic substitutes in reconstruction technics, and in certain of our other cases, resection is not indicated.

Temporary dentures may be constructed from impressions taken the day the teeth are removed; however, more uniformly good results may be obtained if impressions are taken a week or ten days after extraction. I have on record more than twelve patients in my private practice who are still wearing so-called temporary dentures very satisfactorily from eight to twelve years after their construction. However, other cases have required relining, and some, resetting or secondary denture construction. If the desired cosmetic results are obtained in primary denture construction, relining within from one to three years will restore the temporary dentures to accurate cohesive adaptation.

Process resorption is apparently reduced by early denture adaptation. The denture, if constructed properly within ten or twelve days after extraction, acts as a mold for osseous as well as plastic tissue generation; therefore, resorption is retarded by atmospheric pressure, which acts inversely to the cohesive force which stabilizes the denture.

Group dentistry has thus far been a dream, but the extractor must invariably cooperate with the prosthetist. It is not a difficult procedure for an extractor to work a dental mechanism, but the prosthodontist occasionally encounters an arduous task in his endeavors to cover the tracks of his wrecker friend and gain the desired result for the patient—a satisfactory, cosmetic, stable substitute for lost dental organs. One or the other of the specialists, and occasionally both, are justly to blame for unfortunate results; therefore, the two should cooperate for the benefit of their unfortunate victims who, at best, are laboring under a dental efficiency handicap.

## Discussion

*Frederick F. Molt, Chicago, Illinois:* The elimination of infected masses of tissue, both gingival and periapical, should be stressed as an all important result, because in the light of present-day knowledge of focal infection the only safe and sure method of eliminating it is to *eliminate* it. In spite of the chaotic state of mind of the profession in general as to whether these areas of great extent are eventually autogenetically done away with, no one can deny that a pericementoma lying on a sponge on the surgeon's tray is much less a menace to the patient than one remaining *in situ* after the extraction of the tooth that bred it. Going still farther into this point, we may say, with no prospect of contradiction, that the probability of this auto-elimination cannot be predetermined, whether the areas of residual infection are found to be 1 per cent, as claimed by some authorities, or 50 per cent, as claimed by others, since that nebulous factor "resistance" of the patient may not definitely be shown in advance.

If, therefore, it is possible, as it is, thoroughly to eliminate these areas with little discomfort to the patient and with a positive result, it would seem to be quite the logical procedure to "be on the safe side."

The other points brought forth in advocacy of alveolar process resection are an outgrowth of a more scientific consideration of the problem of denture construction, as well as an application thereto of simple rules of mechanics. It has been found undesirable, from the aspect of success in this construction, not to mention the patient's own disinclination, to subject him to the two or three months' wait for "absorption"—a hypothetical kindly act on the part of Mother Nature—to prepare the mouth for successful taking of impressions that would spell success in dentures. Sometimes it did and then, again, sometimes it did not. In process resection, however, we have available an operation that, by anticipating this natural absorption and by "going it one better" in the positive obliteration of undercuts and irritating process margins, makes possible the immediate insertion of dentures which may be worn in comfort and which, with the possibility of requiring readaptation to a slight degree, are permanent. Mourn the passing of the "temporary plate" with its inevitable discomfort and its usual unsightly tooth placement that made it difficult for the patient's friends to recognize him "as is."

The point is well taken that process reduction should not be carried to an excess in order to permit of coaptation of tissue flaps, for that is an inconsequential part of the result. It is far better to permit these flaps to lie 8 or 10 mm. apart than to bring them into contact at the expense of excessive bone cutting or of tension upon the buccal mucous flap, which would lower the mucous fold.

Collaboration with denture prosthetists in this preparation has convinced me that a modified U type ridge, with one side of the U slightly reduced to permit of properly placing the teeth without grinding the ridgelap, is more desirable than the V type that Dr. Lucas advocates. The particular points of desirability are that it gives a more stable seat for the denture in its proper position and continues the peripheral seal unbroken for much longer when the denture is dislodged by lateral thrust.

It necessarily follows that with the facilities at our command in carrying out alveolar resection, a failure to provide for an esthetic as well as a comfortable denture result will be due to lack of judgment on the part of the operator, or lack of cooperation with the dentist who has to cope with the restorative problem, or both.

The inevitable "but" should be, as Dr. Lucas has made it, an accentuated plea for surgical asepsis. No matter how much merit we may attribute to such an operation, no matter how important it may be to achieve, if possible, such a desirably comfortable, esthetic and permanent result, no operator should attempt to carry through this more extensive procedure unless he has learned and subscribed to all the rules that govern aseptic surgery of any kind. It must be admitted that the meaning of the expression "surgically clean" is unknown to an unfortunately large proportion of our profession, for, slaves to precedent, we have depended for many years on the natural immunity and the kindly vascularity of oral tissues to make up for our shortcomings in the way of actual cleanliness. Let no one concede the value of such procedure as is outlined by Dr. Lucas unless he is prepared also to accept as well his statement that it should "not even be contemplated unless the operator is thoroughly familiar with and rigidly adheres to the most strict routine of surgical technic."

*M. R. Howard, Denver, Colorado:* I should like further information from Dr. Lucas on the necessity for medication at the apex of the roots of the teeth after the granulomatous tissues are removed. It has been my practice to use no medication whatever, and good results have been obtained.

Each case presents its own problems for alveolotomy. Generally, buccal and labial processes should be removed before the teeth are removed. This is because of convenience and ease of operation and because the process is more easily detached from the mucoperiosteum before removal of the tooth than afterward. Some cases present, however, when the teeth are loose. Greater convenience may result and the operation expedited by removing the teeth first. Then the rongeur and smoothing instruments may be used and the operation completed the same as with the first method.

*Hugh W. MacMillan, Cincinnati, Ohio:* Of all the sensational and radical operations advanced in recent years, alveolar resection, now called the open view method, deserves more condemnation than all others combined. In the beginning, it takes no consideration of the healing of the normal socket. The old conception, which is so prevalent in our dental literature, that the alveolar process is a transitory structure which appears with the teeth and disappears with the teeth is erroneous and is not supported by facts. If the healed alveolus in any skull showing no evidence of diseased alveolar border is examined, bone will be found to have filled in the alveolus completely up to the level of the alveolar border of the remaining teeth. The result is a flat base with two parallel buccal and lingual walls with slightly rounded edges. This is the ideal base desired and pleaded for by the prosthetist and should be the ideal of every oral surgeon who is interested in the future dental history of the patient. There is no alveolar surgery yet that has improved on the result attained by Nature when left alone. In this discussion, I am perfectly aware of deformities requiring surgical treatment. The same principles here outlined also apply to that treatment.

In researches on bone formation, McEwen has shown that the periosteum has little or no action in the actual laying down of bone. It merely acts as a matrix which determines the conformation of the future restoration. Applying that principle to alveolar regeneration, in order to have an ideally formed ridge, every portion of the buccal plate should be conserved in order to act as a framework for the periosteum, which is thereby held out in its normal position. If the supporting bone is removed, the periosteum will become bound down and the result will be the same as if the supporting bone were destroyed by disease.

For that reason, in the extraction of teeth every particle of bone should be retained, especially in the regions of the tuberosities and around the cuspid eminence. It is my practice to separate the roots of the molars in order to extract them singly and thereby save the outer plate. In the extraction of

superior bicuspids which are surrounded by a heavy cingulum of process, it is my practice to force a chisel, using hand pressure, between the tooth and the alveolar plate, divide this buccal prominence from its attachment and leave it intact with the periosteum. The tooth is then extracted without performing an alveolar resection or buccal plate operation unintentionally. The alveolus is cleared of blood and cleaned from its undesirable contents with not quite so much dispatch but with as much thoroughness as the other method, judging from results.

*William L. Shearer, Omaha, Nebraska:* In 1905, I started a systematic examination of the mouths of edentulous patients ranging all the way from one or more years. At that time, as we know, all that was done was the simple extraction of teeth. This work was carefully carried on for twelve years, during which time 1,800 patients were examined. Out of the 1,800, 527 cases disclosed a knife-like ridge of bone, either of the mandible or the maxilla, so sharp when cut down on with a knife that the alveolar ridge would very easily cut an ungloved finger. All of these patients were to a greater or less degree complaining of some difficulty in wearing their dentures, and invariably complained of pain right on top of the ridge.

We do not find an abrasion of the mucous membrane and, unless one has made repeated examinations, he would not find the cause of the trouble. But when the incision is made, the knife-like ridge of bone is present. It is a remnant of the alveolar process, after resorption, leaving a so-classified osteosclerosed bone, practically void of blood supply. Again, to call your attention to the alveolar process, at birth there practically is none. It develops as the teeth develop and fades away after the teeth are lost by extraction or disease in whole or in part in all cases.

There are many cases in which simple extraction of teeth is all that is necessary. Cases are all different and must be treated in accordance with the findings. One who lays down anything other than the principles of surgery will go astray. One who has not sufficient judgment, when he meets a condition in the oral cavity, to handle it properly should study and investigate until he has mature judgment and can give, in a measure, the proper kind of a service. I think there are none so clever in the removal of teeth, even by forceps or any other means, that they can avoid fractures of the alveolar process. One can readily see, if there is fracture anywhere, that the terminal branches of the nerves, arteries and veins will be cut off between the edges of the fracture and thus be a means of producing future complications through adhesions.

The neurologic complications following in the wake of improper surgery of the mouth after the removal of teeth are past all understanding. H. M. Cryer knew not how truthfully he spoke when he called our attention to this some forty years ago. My teachings in surgery have always been to remove disease wherever encountered, if surgically possible, and to leave no jagged edges of bone anywhere to give trouble.

Dr. Lucas brought out one very important point, that in all cases alveolar resection is not indicated. It is not indicated in all cases any more than is the removal of the gallbladder or the appendix indicated in all cases.

*A. T. Rasmussen, LaCrosse, Wisconsin:* If medication is indicated at all in the infected bony structures referred to by Dr. Lucas, I would like to know why he uses phenol. In my opinion, phenol would be one of the last drugs I would resort to, if I thought medication was advisable, because of its coagulating properties. If I thought I could sterilize the structures beyond the immediate surface by medication, I would choose a more penetrating drug than phenol—one which would penetrate as deeply as possible and not coagulate the cellular structures. I am sure Dr. Lucas must have some reason for using this drug and I would like to know why.

Rather than applying medication of any kind, I depend on Nature's ability to rid the tissues of infection after I have removed the structures that are hopelessly diseased and established free drainage. I believe it is important to maintain good drainage until Nature has had an opportunity to clear up the infection and close the wound with healthy tissue. I consider this of the utmost importance.

One thing that pleased me greatly in this paper was the statement made by Dr. Lucas that not every case should have the alveolar walls resected. I have records of cases in my practice where resection of the alveolar walls was done about eighteen years ago. While my views on this subject have naturally been modified to some extent in that number of years, I have never yet been able to see the advisability or the necessity for the radical cutting away of the buccal and labial alveolar plates in all cases or even in a large majority of cases. On the other hand, I believe that we should exercise great care in the removal of this bone, for the patient's future comfort when wearing an artificial substitute depends largely on the shape in which the ridge is left by the surgeon.

When the buccal or labial plates are healthy and of normal shape, I do not believe that they should be removed to the apex of the tooth root, as advocated by some, even though

there is a periapical infection of the bony structures. Such a periapical area of infection can usually be managed through the socket without sacrificing the buccal and labial plates, and if such a case is properly handled, saving the buccal and labial plates, the resultant ridge will be far better suited to supporting an artificial denture than if the outer plate is removed. Of course, when the bone is hopelessly diseased, we have no choice in the matter. Then, whatever is necessary must be removed. The thin edges of the alveolar process should always be trimmed and smoothed after the removal of tooth roots. The same principle applies here that applies in all other bone surgery, viz., leaving the margin of the bone wound as smooth as possible. By using good judgment in these cases, we can do much to insure the future comfort of our patients.

Resecting the outer plate to, or nearly to, the apex of the tooth roots produces a sharp ridge—a V-shaped ridge, the most unsatisfactory type of a ridge for supporting an artificial denture of any kind. Instead of such extensive resection, producing a ridge, a cross section of which would appear in the form of a triangle with the base attached, we should aim to preserve the natural contour of the alveolar ridges, trimming away only such sharp edges as would interfere with proper healing, and removing any undue prominence of bone which would interfere with the esthetic requirements, or the placing of the denture, thus producing a ridge which is the best possible for supporting and stabilizing artificial dentures. Let us get away from the idea that it is necessary to remove large sections of the osseous structures in order to perform a good operation.

There seems to be a tendency on the part of some operators to sacrifice the alveolar plate in order to close the overlying soft tissues with sutures. I do not believe that this is a good practice. I do not sacrifice one bit of bone (note that I say sacrifice) for the purpose of bringing the edges of the mucoperiosteum into apposition over the socket. I do not think it is necessary. Nor do I close the wound in any case where infection exists in the bone, periapical or otherwise. In all infected cases drainage should be established and maintained until the structures are free of the infecting organism. Again let me say, only Nature can accomplish this.

If the case is one where infection of the bone does not exist, and if you feel that you must close the wound completely, you must not do so at the expense of the outer plate, unless that has to be removed for other reasons. The removal of a little of the edge of the lingual plate will do far less damage to the patient.

*A. B. Crane, Washington, D. C.:* Every dentist is familiar with what he might call an ideal mouth for denture service. We have patients who have worn well-made dentures for a number of years, and, on examination of the arch, we find a condition which is all that can be desired. I feel that we should take such a condition as a standard at which we should aim in any surgical preparation of the mouth for denture service.

As has been stated by Dr. Lucas, many mouths are irreparably ruined by operators who proceed to perform resection of the alveolus without due comprehension of the amount of tissue which should be left following the operation. I think that the common reason for this is that the operation is done in a field of blood. In operating on these cases, except in that class which Dr. Lucas has referred to where the operation is being done for the purpose of immediate denture replacement, my personal preference is to divide the operation into two stages. The teeth should be extracted, such necessary curettage performed as may be indicated, and then the case should be allowed to go for a week or longer in order to give the tissues a chance to assume a stage of healing where the natural inclination of absorption is indicated. At that time a secondary operation can be done to reshape the alveolus for cosmetic purposes, with the bleeding readily controlled, so that the operator will be able to observe just how much of the outer plate of bone should be removed in order to obtain the result that he desires.

I am sorry that Dr. Lucas did not go more into detail in the matter of primary incisions for this purpose. Many cases have been absolutely ruined, so far as an ideal result is concerned, by the excision of too much of the buccal or lingual flap. Where the operation is to be done immediately following the extraction of the teeth, the primary incision should be made along the line of what is to be the lower border of the outer gum flap and before the teeth are extracted at all.

Then we have a definite guide to go by, and we will not make the error of removing too much bone.

*Dr. Lucas (closing):* It is a routine procedure for the general surgeon to apply phenol to the stump of the appendix in appendectomy. This therapeutic treatment as applied in general surgery gave me the idea of using phenol as a germicide in osseous crypts following a curettement of sockets.

Bone surgeons, after curetting osteomyelitic areas, use 95 per cent phenol for sponging the

wounds in the bone after curettement, for the purpose of sterilizing the operated bony tissue.

After discussing with Dr. Rosenow of the Mayo Foundation the use of phenol in sockets after curettement, he came to the conclusion that the use of the phenol in crypts after curettement will not have a deleterious action on the bone tissue and the phenol will sterilize the crypts. Phenol should be neutralized with 70 per cent alcohol immediately following its application in the crypts.

We have never observed an untoward result from the use of phenol and alcohol in crypts. We have observed surgeons make application of 95 per cent phenol in extensively infected abdominal areas during laparotomy and were surprised to note that the phenol was not neutralized with alcohol and that such wounds were immediately closed and, according to records of such cases, the results were entirely satisfactory.

We have consulted with medical men of comprehensive understanding in surgical pathology and have been advised that the use of phenol and alcohol in osseous crypts after curettement is good technic, and after ten years of active practice we are confident that this treatment is justified and indicated.

In discussing root resection technics, Dr. MacMillan indicated the filling in of these areas with newly formed bone. His observation is that the remaining portion of resected roots will become resorbed following resection, and that finally the operated teeth will become exfoliated. My personal clinical evidence in regard to this matter is that every root that I personally have resected in the past has been exfoliated artificially with the two forceps. In other words, root resection in my hands is a failure.

The purpose of root resection is to relieve the patient of focal infection. Radiographically, the relief to the patient from focal infection has been accomplished in many cases, because of radiographic evidence indicating the filling in of new bone in these operated crypts, to the extent of practically coming into contact with the resected root end. However, our bacteriologic investigation of such newly formed bone conclusively proves that this newly formed bone contains or retains the same micro-organism which grew in culture media on inoculation at the time the resection operation was performed; therefore, the relief to the patient of focal infection has not been accomplished and the operation in my hands and in the hands of other operators in cases where we have had an opportunity of checking up bacteriologically is a failure.

Dr. MacMillan stated that the alveolar process of a tooth socket should be retained for the support of the pericemental membrane after extraction, for bone regeneration. I am sure that he intended to insist on the preservation of the alveolar socket for the support of the periosteum instead of the pericemental membrane, since the pericemental membrane usually adheres to the cementum of the root on account of its fibers being firmly attached in the lamellae of the cementum; therefore, it comes away with the tooth at the time of extraction.

Dr. Crane's contention is that we should not try to intrude on Nature's healing process by the employment of any mouth operation such as alveolar process resection, since Nature's efforts are intended to and should produce the best mouth preparation for future dental replacement procedures.

No doubt each of us has observed Nature's efforts in healing fractured bones, in cases which have been left entirely to Nature for repair, without man's assistance. In certain of these cases, for instance fractures of the wrist, Nature has accomplished the result of fracture reduction and osseous union, but how about the alinement? Perhaps Nature's healing efforts could have been improved on by the hand of man in some such cases; therefore, the octogenarian plea that "Nature is the best doctor after all" should be seriously considered before being offered in refuting any surgical procedure.

All surgical endeavors should be directed toward improving conditions, and alveolar process resection is advised as a sane method of procedure in the preparation of mouths for the reception of dentures, but, as stated in my paper, it is not indicated in all cases, but where it is indicated, if properly performed, it will improve on Nature's attempt to accomplish ideal results for the prosthetist.

It was suggested by one discusser that excessive hemorrhage might be the contributing cause of faulty results in alveolar process resection. Hemorrhage should never be an excuse for faulty results in this operation, primarily because hemorrhage may be readily controlled in these cases, if one understands the technic which has been detailed in previous papers. Faulty results of this operation are due solely and entirely to faulty operative procedures and radical methods of operations.

# FOREIGN BODIES OF DENTAL ORIGIN IN THE AIR AND FOOD PASSAGES

By CARLOS E. PITKIN, M.D., Cleveland, Ohio

(Read before the American Dental Association, Cleveland, Ohio, September 10-14, 1923)

IN ANY series of cases of foreign body encountered in the air and food passages, a certain percentage is of dental origin. The percentage is small, to be sure, but the number of such cases is sufficient to warrant their consideration. The term "dental origin" is perhaps misleading, but it is meant to include all foreign bodies of whatever nature entering the air and food passages as a result of dental surgery.

The circumstances under which foreign bodies find their way into the air and food passages divide these cases into two classes. In one class the dental surgeon is entirely responsible, and in the other not at all or only partially so. The dental surgeon is entirely responsible when he is carrying out operative procedure within the oral cavity, and partly responsible when some denture or appliance which he has placed in a patient's mouth becomes detached and is aspirated or swallowed. In one of my cases, suit against a dentist was threatened when a removable bridge became loosened and was swallowed, lodging in the esophagus. Frequently, the foreign body is aspirated or swallowed during sleep or while the person is unconscious or under anesthetic. Artificial dentures and appliances may be loosened while eating and the object swallowed. Occasionally, a foreign body is aspirated into the trachea or bronchi during laughter or an attack of coughing.

The objects, broadly speaking, of dental origin more frequently encountered as foreign bodies are dentures, teeth and fillings; less frequently, are broaches, dental burs, clips, springs, hypodermic needles, detached portions of instruments, atomizer tips, applicators, and cotton or gauze sponges. Any object loose in the mouth and not too large to pass the vocal cords may be aspirated into the trachea or bronchi. A larger object may lodge in the larynx, and a still larger one in the esophagus.

I have knowledge of two recent cases: in one an applicator was aspirated into the trachea while a physician was swabbing the nasopharynx, and in the other the cutting blade of a nasal forceps became detached and entered the maxillary sinus through the natural opening. This could have been aspirated as well.

Eleven cases of a dental broach in the bronchus are recorded. In nine cases the broach was successfully removed endoscopically, and in one case after several unsuccessful endoscopic attempts at removal of a broach from an upper lobe bronchus, a general surgeon performed a thoracotomy. The foreign body was located, but on account of hemorrhage, removal of the upper lobe of the lung became necessary. The patient died.

### Prophylaxis

The person is often at fault for the neglect of loose teeth fillings, crowns and dentures. Attention to these would do away with a few of the accidents. Removable dentures should be taken out of the mouth before retiring or even when taking a nap.

I have been impressed by the care usually taken by dental surgeons to prevent aspiration of foreign bodies during surgical procedures, and it seems impertinent to mention those precautionary measures with which you are all familiar. An accident may happen, however, to the most skilled operator.

During extraction of teeth, the mouth should be so packed with gauze that aspiration of loose teeth, blood clots and infected material is not possible. After the completion of extraction, there should be a strict accounting for all teeth, roots and fillings.

The use of the rubberdam in the preparation of teeth for filling and in the placing of fillings and crowns will prevent the aspiration of any material or instrument used in this procedure. Needless to say, anything loose in the mouth should be removed before the administration of an anesthetic.

In children, the use of the mouth gag often detaches a loose temporary tooth which may be aspirated. This warning applies chiefly to those operating for the removal of tonsils and adenoids.

Digital attempt at removal of a foreign body should never be undertaken, as an object lodged in the pharynx may be pushed farther down, thus making removal more difficult, or the foreign body may be pushed into the larynx. The larynx itself is often severely traumatized, even when a suspected foreign body is not present.

### Diagnosis

A lengthy discussion of the symptomatology of foreign body in the larynx, trachea, bronchi and esophagus is not permissible at this time, but mention should be made of the more important symptoms.

Foreign body in the esophagus may or may not produce symptoms. Dysphagia is the most constant symptom. If the intruder is small, there may be little or no difficulty in swallowing, but in some instances a small foreign body may cause complete obstruction, owing to inflammatory reaction and the accumulation of food about it.

The subjective sensation of a foreign body often persists after the object has passed on or has been removed. Cough may be a symptom due to reflex irritation or the overflow of secretions into the larynx.

The entrance of a foreign body into the larynx causes an immediate laryngospasm, followed by croupy cough and wheezing respiration. Pain may be present or absent. Phonation is usually impaired. Respiratory obstruction may be marked, depending on the nature and size of the intruder, thus making early removal or tracheotomy imperative.

Foreign bodies in the trachea are usually movable, and violent cough is excited by their movement. Dyspnea is often present and increases with the sojourn of the foreign body, owing to the swelling produced by its movements. Sudden shutting off of expiration during cough is characteristic of a loose foreign body in the trachea.

A recently lodged bronchial foreign body usually causes few symptoms, unless the bronchus is completely occluded. With complete occlusion of a bronchus, there is little or no dyspnea. Cough is usually present but may be slight or absent in recent bronchial foreign bodies. In both tracheal and bronchial foreign bodies the asthmatoid wheeze described by Chevalier Jackson is often heard. The wheeze is heard at the patient's open mouth during expiration.

A nonobstructive metallic foreign body may remain in a bronchus for months and produce but few symptoms. Prolonged sojourn of an inorganic foreign body eventually produces cough with copious and usually foul expectoration, chills, fever, emaciation, and pulmonary hemorrhage. Pulmonary abscess is the usual sequel. Many of these cases are mistaken for pulmonary tuberculosis.

A case of this sort was reported before the American Bronchoscopic Society in 1922 by W. B. Chamberlin of Cleveland. The patient, a man, aged 24, in military service at the time, was wearing a dental appliance for the treatment of an ankylosis of the jaw. A stiff wire spring was part of the appliance. This became loosened during sleep and was aspirated into the right bronchus. Complaining of cough following the disappearance of the spring, he reported the occurrence to the surgeon in charge, but no importance was evidently attached to his statement that he thought the spring had gone into his lungs. After two years of cough with expectoration, hemoptysis and loss of weight, he was thought to have pulmonary tuberculosis. A roentgenogram finally revealed the foreign body. It was successfully removed from the bronchus by Dr. Chamberlin, and the patient made a prompt recovery.

When a loose object, be it tooth, appliance or instrument, slips from the operator's fingers or forceps and disappears in the patient's mouth, the assumption should not be that it was swallowed. On the contrary, the operator should assume that the foreign body was aspirated into the trachea or bronchus and act accordingly.

What should be the procedure in the case of a suspected foreign body in the air and food passages? First, a careful mirror inspection of the nasopharynx, pharynx and larynx, followed by physical examination of the chest, and, finally, roentgenologic study. If the roentgen ray fails to locate a foreign body and there is the least suspicion that it is present, endoscopic search should be made for it. The sooner a foreign body in the bronchus or esophagus is removed, the easier will be the task. In the bronchus, the foreign body tends to work downward, and swelling of the mucosa partially obscures it. After a longer time, granulations and finally stricture may hide it. Prolonged stay of a foreign body in the esophagus may cause ulceration into the trachea or mediastinum, in the latter case causing a fatal mediastinitis.

Bronchoscopy and esophagoscopy are safe procedures if skillfully performed. In children, and often in adults, no anesthesia, general or local, is required. In cases of very large or sharp-edged objects in the esophagus, general anesthesia is preferred, as the esophagus is relaxed and there is less danger of trauma in withdrawal of the foreign body.

In my small series of forty foreign bodies removed from the air and food passages, three are of dental origin and are of sufficient interest to warrant reviewing.

## REPORT OF CASES[1]

CASE 1. A man, aged 48, while eating his evening meal, swallowed an artificial denture in the form of a removable bridge, bearing two molar teeth. This was held in place by a gold band conforming to the palatal arch and extending to the opposite side, where it fastened between two molar teeth; extending forward from this gold band and resting on the palate was a projection 26 mm. long, the whole device resembling the letter F.

The patient was sent to a hospital that evening. A roentgenogram showed the denture partly in the hypopharynx, teeth down and straight side of F to the left. Under general anesthesia, a prolonged and unsuccessful attempt by other physicians was made at removal, at first blindly and then with the aid of an esophagoscope.

I saw the patient the following afternoon. He was having considerable pain and was unable to swallow anything. He was quite hoarse. There was considerable emphysema

1. Referred by Dr. G. M. O'Neill.

in the neck and over the upper part of the chest. A roentgenogram showed the foreign body in the esophagus, somewhat lower than in the first roentgenogram.

Under general anesthesia, a short Mosher esophagoscope was introduced and the intruder seen lying below the crico-pharyngeal fold. There was considerable swelling of the esophageal mucosa. Only half of the band and the projecting arm could be seen. Extraction was accomplished with difficulty by a blunt hook placed over the projecting arm. There was no apparent trauma. The following day the patient could swallow liquids with some pain. Indirect inspection of the larynx showed paralysis of the left cord. Recovery was complete in a few days, with the exception of the paralysis of the vocal cord, which persisted for a month.

CASE 2. A man, aged 26, while eating his midday meal, swallowed about one-third of a broken tooth plate, two teeth being attached to the portion swallowed. A roentgenogram showed the broken piece in the upper end of the esophagus. Four hours after the accident, removal under local anesthesia was attempted by a colleague. He succeeded in bringing the plate into view with the esophagoscope, and grasped it with alligator forceps, but more force was required to dislodge it than he thought wise to apply, so he abandoned the attempt.

Examination of the remainder of the broken plate gave valuable information relative to the size and shape of the piece in the esophagus. The mechanical problem was impaction of a thin, horizontally placed object with sharp corners and measuring about 3.5 cm. The following day, under general anesthesia, the short Mosher esophagoscope was introduced and the plate brought into view. It was seized with rotation forceps near the right corner, rotated and withdrawn without difficulty. Recovery was without event. Failure of the first attempt was apparently due to the presenting part of the object being grasped firmly in the center with alligator forceps and no rotation allowed. Local anesthesia did not permit complete relaxation of the esophagus.

CASE 3. During extraction of a third molar tooth under general anesthesia, in a man, aged 43, the tooth slipped from the grasp of the forceps and disappeared. The operator, alive to the possibilities, at once had a roentgenogram of the thorax made, showing the tooth in the right main bronchus. Bronchoscopy under general anesthesia was performed an hour and forty-five minutes after the accident, and the tooth quickly removed. Recovery was without event. One might say that this was a model case, because of the quick and thoughful action on the part of the dental surgeon.

## CONCLUSIONS

1. Foreign bodies in the air and food passages of dental origin are of frequent enough occurrence to warrant thoughtful consideration.

2. A variety of objects of dental origin have been encountered as foreign bodies in the air and food passages.

3. Diagnosis of foreign body is made by careful physical examination of the chest, by roentgenography and, in doubtful cases, by endoscopy.

4. Prolonged sojourn of a foreign body in a bronchus produces serious damage to the lung. Lung abscess is the usual sequel. Foreign body in the esophagus may produce ulceration and penetration with fatal outcome.

5. Skillfully performed bronchoscopy and esophagoscopy are safe procedures.

6. Any object disappearing from the mouth during an oral surgical procedure should not be assumed to be swallowed, but rather to be aspirated, until the contrary is proved.

7. Greater care on the part of both patient and dental surgeon will lessen the frequency of foreign body accidents.

The Journal of the American Dental Association

5 North Wabash Avenue, Chicago, Illinois.

Please send in promptly notice of change of address, giving both old and new. Important information regarding subscription price, etc., will be found in the advertising pages.

## *Editorial*

### TOOTH CLEANSING AND BLEACHING AGENTS

Recently there seems to be cropping up here and there in different sections of the country various agents advocated for cleansing, bleaching and beautifying the teeth. They are advertised to the public and are sold by druggists, and the harm that may result can hardly be estimated. Every dentist knows full well that any agent which will remove stains from the teeth and whiten them by its mere application will do a definite damage to the tooth structure. This has been so patent to the profession that dentists have gone on from time immemorial laboriously removing these stains by mechanical means. What a world of useless labor has been expended on the part of the profession if these prestochange methods were effective, reliable and harmless!

But they are not harmless, and in all probability the promoters know this. It is a prolific means of catching the unwary, and it so chances that the field is ripe at the present time. There probably never was a period in the history of the human race when the rank and file of the people were so generally interested in the teeth as they are today. Mouth hygiene has come to be a matter of almost universal discussion among the laity, and the condition and appearance of the teeth are held to be in a large measure significant of health and civilization.

What is more natural, then, than to find people reading these advertisements and catching at what seems to them a simple means of improving the appearance of their teeth? It would be bad enough if—as with many other nostrums—they merely failed to do the service claimed for them, but were otherwise harmless. We all know that they are not harmless—that some of them are really seriously dangerous; and it is the duty of our dental publications and of the dentists themselves to utter a word of warning on every occasion. Professional men should stand between the people and the impostor at all times, and while they may get little thanks for their pains, and while their motives are frequently impugned, this should not deter them from doing their bounden duty in the case.

It is not possible to nip in the bud all the evil practices that are foisted on the public. The ingenuity of the promoters is such that they catch the unwary while honest men are asleep, and thus it is that much harm is done before the public is awake to its danger. But this is one scheme that is so notoriously harmful on its face that there should be little trouble in stamping it out, and this will be accomplished as soon as the profession unites in a common campaign against it.

It is needless to say that no reference whatever is hereby made to the various toothpastes or powders on the market which are to be applied with the brush in the usual way, but merely to those agents of strongly chemical content which will act directly on the enamel by simple application without friction.

## INCREASE IN DUES

A county medical society secretary advises us that two members of his society have refused to pay the dues for 1924 because of the increase voted at the annual session. Perhaps medical societies are better off without members who are so narrow-minded as to object to the dues asked of them for this year. Really a doctor who objects to paying his medical association dues, even though they were three times what are now asked, ought to hang his head in shame, for he marks himself as both unprogressive and selfish. We feel certain that the state association will lose few members as a result of the increase in dues, and those that it does lose are perhaps no credit to the association anyway.—Editorial, Journal of the Indiana State Medical Association, Jan. 15, 1924.

## IN MEMORIAM

### Dean Dunwody Atkinson

By Newton A. Teague, D.D.S., Augusta, Georgia

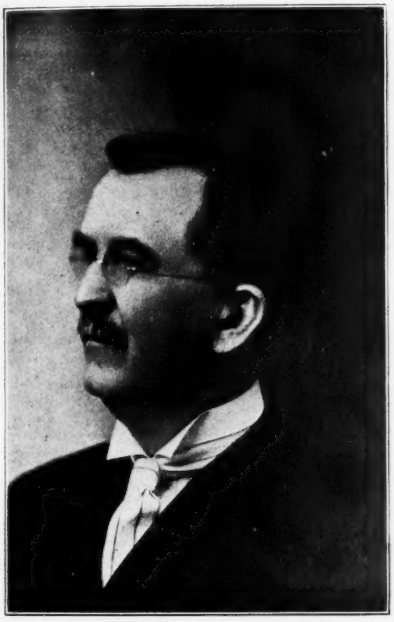
Dr. Dean Dunwody Atkinson was born at Incachee Plantation, Camden County, Georgia, Sept. 27, 1858, and died of angina pectoris at Brunswick, Georgia, Jan. 6, 1924. The interment was at Palmetto Cemetery, Brunswick.

Dr. Atkinson graduated from the Pennsylvania College of Dental Surgery, Feb. 27, 1880, and began the practice of dentistry first in Camden County, and later at Brunswick, Georgia, continuing his practice there until his death.

He was married to Sara Hardee Scarlett, Dec. 5, 1883. The immediate survivors are: Mrs. Sara H. Atkinson; two daughters, Mrs. F. E. Allen and Mrs. A. D. Little; four sons, David S., and Drs. Spencer R., Frank B., and Dean B. Atkinson, Jr.

Dr. Atkinson was a member of the Eleventh District Dental Society and the Georgia State Dental Society, and also of the American Dental Association. He was an ex-president of the Georgia State Dental Society, and the secretary of the State Board of Dental Examiners at the time of his death, having served for

twenty-eight years. He was also president of the National Association of Dental Examiners and an Honorable Fellow of the Georgia State Dental Society. The American Dental Association conferred on him the degree of F.A.C.D. at the Los Angeles meeting in 1922. Dr. Atkinson was also active in civic and religious affairs. He was mayor of Brunswick, Georgia, from 1898 to 1900, and he was a member of the Methodist Episcopal Church, and chairman of the Board of Stewards of the First Methodist Church, Brunswick, for twenty-eight years.



Dr. Atkinson was a prominent member of the dental profession, state and national, as evidenced by the positions he held in both organizations. Possessed of sterling qualities which endeared him not only to his clientele at home, but also abroad throughout the state, his fame as a dentist extended, while his friends were legion. He kept abreast with the progress of his profession, and was endowed with exceptional qualities of mind and heart; he was a brilliant speaker, always in demand at state conventions; he was a ripe scholar, and, withal, he was a just man, considerate of others.

The niche he filled, officially and in the affections of his confréres, stood in bas-relief above the average man and member of his profession. His sympathetic solicitude and friendly advice were extended always where needed most. His brilliant wit and reputation as an after-dinner speaker gathered around him a host of admirers on festive occasions.

The passing away of this scholarly man and loyal friend is attended with a sense of loss, keenly felt by the members of Georgia State Dental Society and other friends, among whom he lived and moved and had his being. This society, bereft of his companionship, influence and urbanity of manner, is poorer indeed.

We shall gratefully remember his long years of faithful service and rectitude as secretary of the Board of Dental Examiners. His literary contributions and clinics before the society, and his efforts at all times to promote the upbuilding of his profession and its maintenance of supremacy among the learned professions are well known and appreciated.

In his daily walk in life, his compassion and friendly interest shown to people have given heart to the discouraged and comfort to the sorrowing, and by these contributions he has made the world a better place to live in. There was purity in his every thought and nobility in his every purpose; his heart was golden and his soul sincere.

Bowed down with grief at his sudden death and the loss sustained by his removal from his sphere of usefulness among us, we can only lower our heads, and with deep humility and sorrow offer silent prayers for the soul of this generous-hearted Christian gentleman—a man *sans peur et sans reproche.*

# RUSSIAN RELIEF

## AMERICAN DENTAL ASSOCIATION

**Arkansas State Dental Society**

| | | |
|---|---|---|
| *Cash | $ | 5.00 |

**California State Dental Society**

| | | |
|---|---|---|
| *Cash | $ 25.10 | |
| California State Dental Society | 660.00 | |
| | $ | 685.10 |

**Colorado State Dental Society**

| | | |
|---|---|---|
| *Cash | | 302.50 |

**Connecticut State Dental Society**

| | | |
|---|---|---|
| Connecticut State Dental Society | | 400.00 |

**Florida State Dental Society**

| | | |
|---|---|---|
| *Cash | | 200.00 |

**Georgia State Dental Society**

| | | |
|---|---|---|
| *Cash | | 50.00 |

**Illinois State Dental Society**

| | | |
|---|---|---|
| *Cash | $2,091.50 | |
| Knox County Dental Society | 12.50 | |
| | $ | 2,104.00 |

**Indiana State Dental Association**

| | | |
|---|---|---|
| *Cash | | 233.00 |

**Iowa State Dental Society**

| | | |
|---|---|---|
| *Cash | | 110.00 |

**Maryland State Dental Society**

| | | |
|---|---|---|
| *Cash | | 5.00 |

**Massachusetts State Dental Society**

| | | |
|---|---|---|
| *Cash | | 5.00 |

**Michigan State Dental Society**

| | | |
|---|---|---|
| *Cash | | 5.00 |

**Minnesota State Dental Society**

| | | |
|---|---|---|
| *Cash | $ 15.00 | |
| L. R. Hoelzle, St. Paul | 5.00 | |
| | $ | 20.00 |

**Mississippi State Dental Society**

| | | |
|---|---|---|
| *Cash | | 200.00 |

**Missouri State Dental Society**

| | | |
|---|---|---|
| *Cash | $ 6.00 | |
| H. I. Bragg, Columbia | 2.00 | |
| T. P. Cronkhite, St. Joseph | 1.00 | |
| Donald F. Mosher, Kansas City | 1.00 | |
| | $ | 10.00 |

**Navy Dental Corps**

| | | |
|---|---|---|
| *Cash | | 2.00 |

**New Jersey State Dental Society**

| | | |
|---|---|---|
| *Cash | | 10.00 |

**New York State Dental Society**

| | | |
|---|---|---|
| *Cash | $ 825.00 | |
| Mrs. E. Faber, Brooklyn | 5.00 | |
| | $ | 830.00 |

**North Carolina State Dental Society**

| | | |
|---|---|---|
| *Cash | | 300.00 |

**North Dakota State Dental Society**

| | | |
|---|---|---|
| *Cash | | 10.00 |

**Ohio State Dental Society**

| | | |
|---|---|---|
| *Cash | | 500.00 |

**Oklahoma State Dental Society**

| | | |
|---|---|---|
| *Cash | | 4.00 |

**Pennsylvania State Dental Society**

| | | |
|---|---|---|
| *Cash | $ 165.00 | |
| Adolph Salgo, Philadelphia | 2.00 | |
| | $ | 167.00 |

**Southern California Dental Society**

| | | |
|---|---|---|
| *Cash | | 632.00 |

**South Dakota State Dental Society**

| | | |
|---|---|---|
| *Cash | | 11.00 |

**Tennessee State Dental Society**

| | | |
|---|---|---|
| Nashville Dental Society | | 55.50 |

**Texas State Dental Society**

| | | |
|---|---|---|
| *Cash | | 214.00 |

**Washington State Dental Society**

| | | |
|---|---|---|
| *Cash | | 10.00 |

**West Virginia State Dental Society**

| | | |
|---|---|---|
| *Cash | | 2.00 |

**Wisconsin State Dental Society**

| | | |
|---|---|---|
| *Cash | | 15.00 |

| | | |
|---|---|---|
| Total amount received from state societies | $ | 7,097.10 |
| *Contributions paid direct to Dr. Floristan Aguilar, Madrid, Spain | | 2,604.00 |
| Total American Dental Association February 14, 1924 | $ | 9,701.10 |

## RUSSIAN RELIEF

## AMERICAN DENTAL TRADE ASSOCIATION

| | | |
|---|---|---|
| *Cash | $4,772.00 | |
| L. D. Caulk Co., Milford, Del. | 250.00 | |
| Victor X-Ray Corp., Chicago | 100.00 | |
| Wilmot-Castle Co., Rochester, New York | 50.00 | |
| Norton-Starr Co., Syracuse, N. Y. | 50.00 | |
| Gwinner-Mercere Co., Memphis, Tennessee | 25.00 | |
| Osmun-Cook Co., Newark, N. J. | 25.00 | |
| Hettinger Bros. Dental & Surgical Supply Co., St. Louis, Mo. | 25.00 | |
| J. W. Ivory Co., Philadelphia, Pa. | 10.00 | |
| Dentists & Surgeons Supply Co., Springfield, Mass. | 10.00 | |
| Spyco Smelting & Refining Co., Minneapolis, Minn. | 10.00 | |
| Total American Dental Trade Association | $ | 5,327.00 |

### RUSSIAN RELIEF

#### FOREIGN

| | |
|---|---|
| *Cash | $ 7.17 |
| Total Collections to February 14, 1924 | $15,035.27 |

#### MAGAZINES AND DENTAL INSTRUMENTS

L. V. Magoon, Chicago, Ill. (Magazines).

## JAPANESE RELIEF

### AMERICAN DENTAL ASSOCIATION

| | | |
|---|---|---|
| *Cash | $ 175.00 | |
| Rochester Dental Society, N. Y. | 193.00 | |
| C. E. Blandenburg, Augusta, Ga. | 25.00 | |
| J. Howard, Gaskill, Pa. | 10.00 | |
| Henry C. Raymond, Detroit, Mich. | 10.00 | |
| A. J. Low, Roslyn, Wash. | 5.00 | |
| D. L. Yingling, Johnstown, Pa. | 5.00 | |
| Adolph Salgo, Philadelphia, Pa. | 2.00 | |
| C. W. Bruner, Waterloo, Iowa | 1.00 | |
| C. R. Townsend, Klamoth Agency, Oregon | 1.00 | |
| Knox Co. Dental Society, Illinois | 12.50 | |
| | $ | 439.50 |
| Less $5.00 ($30.00 erroneously credited in February Journal to Dr. C. Kabell, Chicago, Ill. $5.00 was contributed to Relief Fund, A. D. A. and $25.00 to Japanese Relief | 5.00 | |
| Total Collections to February, 14, 1924 | $ | 434.50 |

### DENTAL INSTRUMENTS, BOOKS, MAGAZINES AND SUPPLIES

*Additional instruments, supplies, books and magazines received:

E. G. Link, Rochester, N. Y., (Dental Forceps).
Reid & Robinson, Regina, Sask. (Instruments).
L. V. Magoon, Chicago, Ill. (Magazines).
J. H. Johnston, Roundup, Mont. (Books).
R. W. Leigh, Washington, D. C. (Instruments).
J. A. Wells, Shawnee, Okla. (Books, Magazines and Instruments).
J. B. Williams, Ashland, Wis. (Books and Magazines).
C. W. Bruner, Waterloo, Iowa (Magazines).
Dr. Schrader, Independence, Iowa (Magazines).
G. L. Stookey, Salt Lake City, Utah, (Magazines).
W. A. Kerrison, Wilbur, Wash. (Instruments).
A. J. T. Lima, Fall River, Mass. (Magazines).
W. H. Moos, St. Cloud, Minn. (Instruments).
Walter G. Fanning, Danvers, Mass. (Magazines).
F. C. Brush, New York City (Magazines).
L. V. Wagoner, Chicago, Ill. (Instruments).
B. F. Blanton, Sikeston, Mo. (Instruments).
I. S. Miller, Jersey City, N. J. (Magazines).
Pendleton & Arto, Inc., Houston, Texas, (Instruments).
F. L. Rountree, Cedartown, Ga. (Instruments).
Geo. L. Carlson, Geneva, Neb. (Magazines).

*Itemized list of contributors published in previous issues of The Journal.

# Announcements

## CALENDAR OF MEETINGS

### NATIONAL SOCIETIES

American Dental Association, November 10, 11, 12, 13, 14, 1924, Dallas, Texas.

American Medical Association, June 9-13, 1924, Chicago, Illinois.

American Society of Orthodontists, March 18-21, 1924, Kansas City, Missouri.

Dental Protective Association of the United States, 4:00 p. m., December 15, 1924, Palmer House, Chicago, Illinois.

National Association of Dental Examiners, November 10, 11, 1924, Dallas, Texas.

### STATE SOCIETIES

National Capital, at Washington, D. C., first Tuesday of every month.

March

Louisiana, at New Orleans (12, 13, 14, 15).
Vermont, at Burlington (19, 20, 21).

April

Alabama, at Montgomery (8, 9, 10, 11).
Connecticut, at Waterbury (24, 25, 26).
Kansas, at Topeka (28, 29, 30).
Kentucky, at Louisville (7, 8, 9, 10).
Michigan, at Flint (14, 15, 16).
New Jersey, at Trenton (9, 10, 11, 12).
North Carolina, at Raleigh (21, 22, 23).
Oklahoma, at Enid (22, 23, 24, 25).
Virginia, at Norfolk, (28, 29, 30).

May

Arkansas, at Ft. Smith (12, 13, 14).
California State, at San Francisco (26, 27, 28, 29).
Illinois, at Springfield (13, 14, 15).
Indiana, at Indianapolis, (19, 20, 21, 22).
Iowa, at Des Moines (6, 7, 8).
Maryland, at Baltimore (5, 6, 7).
Massachusetts, at Boston (5, 6, 7, 8, 9).
Mississippi, at Jackson.
Missouri, at Excelsior Springs (26, 27, 28).
Nebraska, at Lincoln (19, 20, 21, 22).
New York, at Binghamton (7, 8, 9, 10).
Pennsylvania, at Pittsburgh (13, 14, 15).
South Dakota, at Huron (1, 2, 3).
Tennessee, at Chattanooga (5, 6, 7).
West Virginia, at Huntington (19, 20, 21).

June

Colorado, at Glenwood Springs (19, 20, 21).
New Hampshire, at The Weirs (18, 19, 20).
North Dakota, at Grand Forks (4, 5, 6).
Southern California, at San Diego (24, 25. 26).
Utah, at Salt Lake City.
Wyoming, at Cody (16, 17, 18).

July

Wisconsin, at Milwaukee (8, 9, 10).

November

American Dental Association, at Dallas (10, 11, 12, 13, 14).
Arizona, at Phoenix.
Texas, at Dallas (10, 11, 12, 13, 14).

December

Ohio, at Columbus (4, 5, 6).

### MEETINGS OF STATE BOARD OF DENTAL EXAMINERS

Indiana, June 9 to 14. Secretary, H. C. McKittrick, 1006 I.O.O.F. Building, Indianapolis, Indiana.

Iowa, at Iowa City, May 26, 1924. Secretary, C. B. Miller, 726 Fleming Building, Des Moines, Iowa.

Massachusetts, March 11, 12, 13, 14. Secretary, J. N. Carriére, 146 State House, Boston, Massachusetts.

New Jersey, at Trenton, June 23. Secretary, John C. Forsyth, 429 E. State St., Trenton, New Jersey.

Vermont, at Montpelier, June 30 to July 2. Secretary, Philip E. Mellen, Middlebury, Vermont.

## SOUTH DAKOTA STATE DENTAL SOCIETY

The forty-second annual session of the South Dakota State Dental Society will be held at Huron, May 1-3, 1924.

CHESTER K. WALKER, *Secretary*,
Huron, S. D.

## IOWA STATE BOARD OF DENTAL EXAMINERS

The next examination to be given by the Iowa State Board of Dental Examiners will be held in the College of Dentistry of the University of Iowa, Iowa City, beginning at 9 a. m. Monday, May 26, 1924. An examination for hygienists will also be given. For further information and application blanks, address

C. B. MILLER, *Secretary*,
726 Fleming Bldg.,
Des Moines, Iowa.

## VERMONT BOARD OF DENTAL EXAMINERS

The next meeting of the Vermont Board of Dental Examiners for the examination of candidates to practice in Vermont will be held at the State House, Montpelier, June 30 to July 2, 1924. Candidates will present for registration and preliminaries at 10 a. m., June 30. To be eligible for examination, a candidate must be (1) 21 years of age; (2) a graduate of a high school of first class, and (3) a graduate of a reputable dental college. Applications must be in the hands of the secretary not later than June 20.

For further information and application blanks, address

PHILIP E. MELLEN, *Secretary*,
Middlebury, Vermont.

## ALUMNI ASSOCIATION OF THE CHICAGO COLLEGE OF DENTAL SURGERY

The next annual meeting of the Alumni Association of the Chicago College of Dental Surgery will be held April 7 and 8. There will be clinics and lectures given on every important phase of dentistry, to which the profession is cordially invited.

EARLE H. THOMAS, *President*.
H. R. H. BREVIG, *Secretary*.

## MEETING OF ORGANIZATION COMMITTEE OF THE SEVENTH INTERNATIONAL DENTAL CONGRESS

Feb. 12, 1924.

To the Members of the Committee of Organization of the Seventh International Dental Congress:

You are herewith advised that the first formal session of the Committee of Organization of the Seventh International Dental Congress will be held at the Congress Hotel, Chicago, on Wednesday evening, March 5, at 5 o'clock. We will reconvene at a mutually agreeable time on the following day if there should be any unfinished business.

Fraternally, yours,
OTTO U. KING, *Secretary*.

## ODONTOLOGICAL SOCIETY OF CHICAGO

Resolution on the Death of William Whitford.

WHEREAS: This society having learned of the death of its official stenographer, Mr. William Whitford, and

WHEREAS: His long years of service to the Society, together with his great ability and the sterling quality of his character had made a lasting impression on our members, therefore be it

*Resolved:* That we wish to go on record as expressing our profound sorrow at his removal from our midst, and our deep appreciation of his many delightful attributes of mind and personality, which had endeared him to our entire membership, and which remain with us his best and most lasting heritage. Also that we express to his family our sincerest sympathy, and our greatest good will.

(Signed) C. N. JOHNSON,
*Committee*.

## DINNER TO BE GIVEN TO DR. M. L. RHEIN BY THE PATHODONTIA SECTION

The Section on Pathodontia of the First District Dental Society of the State of New York will give a dinner in honor of the founder of the section, M. L. Rhein, D.D.S., M.D. The dinner will be held at the Hotel Commodore in New York City on Friday evening, March 28, 1924.

For information and reservations, address

JOHN T. HANKS,
*Chairman Dinner Committee*,
110 West 42nd Street,
New York City.

# AMERICAN DENTAL ASSOCIATION

## SIXTY-SIXTH SESSION

## DALLAS, TEXAS, NOVEMBER 10-14, 1924

## HOTEL RESERVATIONS

In securing hotel reservations for the coming convention, consult the hotel rate-sheet and fill out the blank application below. Mail it *immediately* to the *hotel* of your choice. The hotel will then advise you of the reservation it has made for you.

KEEP THIS REMINDER OF YOUR RESERVATION

Hotel Selected .....

No. of Rooms .....

No. of Persons .....

Date of Reservation .....1924.

Detach here and keep for reference

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## MAIL THIS APPLICATION DIRECT TO HOTEL

## HOTEL RESERVATION

### American Dental Association, Dallas, Texas, November 10-14, 1924

.....HOTEL .....1924

Dallas, Texas

*Please reserve for me the following:*

.....Room(s) with bath for.....people. Rate desired $.....
(per day)

.....Room(s) without bath for.....people. Rate desired $.....
(per day)

I hereby agree to pay for rooms described from morning / evening of November.....to November ....., unless cancellation is made by October 20, 1924.

*List names and addresses of all who will occupy room with you.*

Name ..... Address .....
Street, City and State

Name ..... Address .....
Street, City and State

Name ..... Address .....
Street, City and State

Name .....

Street .....

City ..... State .....

## HOTEL ROOM RATES—DALLAS

| HOTEL | ROOM WITH BATH | | ROOM WITHOUT BATH | |
|---|---|---|---|---|
| | One Person per day | Two Persons per day | One Person per day | Two Persons per day |
| ADOLPHUS<br>Akard and Commerce Sts. | 2.50-7.00 | 5.00-10.00 | 2.50- | 4.00- |
| JEFFERSON<br>Opp. Union Station | 2.50-3.00 | 4.00- 8.00 | 1.50- | 3 00- |
| ORIENTAL<br>Akard and Commerce Sts. | 1.50-3.00 | 4.00- 8.00 | 1.50-2.00 | 3.00- |
| SOUTHLAND<br>Main and Murphy Sts. | 2.50-3.00 | 3.00- | 1.50-3.00 | 3.00- |
| ST. GEORGE<br>1012 Main St. | 2.00-3.00 | 4.00- 6.00 | 1.00-1.50 | 2.00-3.00 |
| WALDORF<br>1302 Commerce St. | 3.00-3.50 | 4.00- 6.00 | 1.25-2.00 | 2.50- |
| MILAM<br>2013 Main St. | 2.50- | 3.50- | 1.50- | 2.50- |

Members are requested to procure roommates, especially those members from the larger centers, who are requested to go four or five in a large room, for by so doing they will get better rooms.

FRATERNITY HEADQUARTERS

| | |
|---|---|
| XI PSI PHI, | ADOLPHUS HOTEL |
| DELTA SIGMA DELTA, | JEFFERSON HOTEL |
| PSI OMEGA, | ORIENTAL HOTEL |

### NEW YORK STOMATOLOGICAL SOCIETY

The next monthly meeting of the New York Stomatological Society will be held Monday, March 31, 1924, at 3 p. m. at Aeolian Hall, Suite 1504, New York City. Dr. Rex Taylor will present a paper and hold a clinic on "Prophylaxis and Restorations."

A class in pyorrhea is being organized under the supervision of the postgraduate department, with John L. Kelly, D.M.D., and Alfred Asgis, Sc.B., D.D.S., as instructors.

ALFRED ASGIS, *President.*
STANLEY SLOCUM, *Secretary.*
597 Fifth Avenue, New York, N. Y.

### NEW BOOKS RECEIVED FOR THE LIBRARY OF THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION

The Journal of the American Dental Association promptly acknowledges herewith the receipt of new publications. Books selected from those named on this list are reviewed below. Reviews are matter-of-fact statements of the nature and contents of the publication referred to and are intended *solely to guide possible purchasers.*

*"Oral Surgery."* Stewart Leroy McCurdy, Professor of Anatomy and Oral Surgery (Dental), University of Pittsburgh. Ed. 2. 469 pp., 307 illustrations. Pittsburgh Dental Publishing Company, Pittsburgh, Pa.

*"Practical Dental Porcelains."* J. F. Hovestad, D.M.D. Chairman of the Boston Study and Clinic Club, Boston, Mass. 160 pp., 121 illustrations. C. V. Mosby Company, St. Louis, Mo. $3.75.

*"Geriatrics." A Treatise on the Prevention and Treatment of Diseases of Old Age and the Care of the Aged.* Malford W. Thewlis, M.D., Editor, Medical Review of Reviews. Ed. 2, revised and enlarged. 401 pp., 24 illustrations. C. V. Mosby Company, St. Louis, Mo. $4.50.

# *Are You A Prejudiced Juror?*

By ERNEST V. MADISON

A rural resident of a certain state had been a member of many juries in the criminal courts of his country, and it was rumored that, regardless of evidence and circumstances, he was always in favor of a conviction. One day a friend inquired the reason for this severity and he received this reply: "Well, Sam'l, I allus figgers they's guilty or they wouldn't be in court."

* * * * *

Are you a prejudiced juror in the case of your buying knowledge? Do you give it the benefit of the doubt, or do you "figger" that the products you have used in the past are the best for your professional use merely because they have been used.

The dentist should not delude himself with the idea that his buying knowledge is at the highest possible point of efficiency. He should go over it and see that its various component parts are stamped with the year 1924. He should eliminate the wheeze, clatter, squeaks and friction of Antiquity.

The safe way for the dentist to be modern is through the advertising section of *The Journal of the American Dental Association.* Here are told the condensed facts about many products used by others in the field. The careful reading of the different advertisements will determine which of the products advertised are best adapted to your conditions.

There is an analogy between your position and that of a juror. Do not close your eyes and ears to the evidence. Listen to it, read it, and then separate the facts from the claims.